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April 1, 2011
Project 04516-3

Mr. Steve Johnson
Bureau of Waste Site Cleanup
Massachusetts Department of Environmental Protection
205B Lowell Street
Wilmington, MA 01887

Local
History
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GEI

Dear Mr. Johnson:

Re: Response to Notice of Audit Findings and Notice of Noncompliance
50 Tufts Street
Somerville, Massachusetts
MassDEP RTN: 3-23246

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, GEI Consultants, Inc. (GEI) is responding to the Notice of Audit Findings, Notice of Noncompliance (NOAF/NON) (NON-NE-11-3S004), and Audit Memorandum (Attachment A) from the Massachusetts Department of Environmental Protection (MassDEP) dated February 1, 2011. The NOAF/NON states MassDEP's findings and conclusions with respect to IRA Completion Report and Remedial Monitoring Report (RMR) No. 11 (IRA Completion Report) submitted for the 50 Tufts Street Site, Somerville, Massachusetts (the Site) on November 13, 2009.

1. Errors in the NOAF

The IRA Completion Report reflects the results of Site assessment, risk characterization, remedial evaluation, and remedial implementation work conducted over the course of four years at one of the most complex sites in the Commonwealth. MassDEP has been actively involved in each phase of response actions at the Site. Throughout the process, MassDEP has announced changes in policies which it has imposed and GEI, on behalf of UniFirst, has implemented at the Site. The NOAF/NON announces further changes in MassDEP policies, including exposure assumptions to be employed for presently unoccupied basements with at least 7 feet of head space, which now are being implemented.

Prior to submission of the IRA Completion Report, GEI evaluated 115 properties for the presence of a complete vapor intrusion pathway. The NOAF/NON raises questions with respect to only seven of those properties. In comparison to the multi-volume IRA Completion Report, and the dozens of other submittals that preceded it, the NOAF/NON is quite brief.

Between the date on which the IRA Completion Report was filed and the date on which the NOAF/NON was issued, MassDEP elected to transfer responsibility for the Site to a different project manager. Given the number of properties, volume of data, and long history of communications among GEI, MassDEP, and property owners at this Site, it is perhaps not surprising that the NOAF/NON contains multiple misstatements of fact and, overall, reveals a fundamental misunderstanding of the history, basis and status of evaluations, determinations, and

response actions completed at the Site. Notwithstanding its brevity, factual errors made in the NOAF/NON include the following:

1. The NOAF/NON inaccurately states that mitigation systems were not offered to the owners of 105-107 Washington Street and 111 Washington Street. As stated in Section 4.9.2 of the IRA Completion Report, an Exposure Pathway Elimination Measure (EPEM) was offered to each of these property owners, and the EPEM was refused.
2. The NOAF/NON inaccurately identifies 95R Franklin Street in Table 1 as a home with a conventional sub-slab depressurization system (SSDS). 95R Franklin Street has a passive EPEM. An SSDS was originally installed at 95R Franklin Street; however, due to Site-specific conditions typical in this neighborhood, the SSDS was ineffective in mitigating the vapor intrusion pathway to levels that constitute a condition of No Significant Risk (NSR). MassDEP erroneously identified 95R Franklin Street as an example supporting the presumed effectiveness of SSDSs at the Site. To the contrary, a passive system was installed precisely because a conventional SSDS of the kind MassDEP presumes to be effective at most sites was not effective due to building construction and other conditions at 95R Franklin Street.
3. The data presented in Table 1 for 95R Franklin Street are inaccurate. Three rounds of post-SSDS installation data were collected and concentrations of tetrachloroethylene (also known as perchloroethylene [PCE]) were measured at concentrations up to 19 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). By contrast, four rounds of indoor air samples have been collected since installation of the passive system, and PCE has not been detected above laboratory reporting limits in any. The passive system has been highly effective. Notably, the soil gas concentrations beneath the house at 95R Franklin Street are some of the highest encountered at the Site ($108,000 \mu\text{g}/\text{m}^3$).
4. The NOAF/NON inappropriately relies on 23 Tufts Street as if it presents a typical scenario at this Site where a conventional SSDS has been shown to be effective. This property is far from typical. It is a comparatively new single-family home built within the last 20 years with a poured concrete basement and good sub-slab communication. The majority of residences at the Site are over 100 years old, were constructed with field stone foundations, and have compromised basement floors. Conditions at 23 Tufts Street in fact are the exception, not the rule.
5. It is clear from the NOAF/NON that MassDEP has misunderstood or simply forgotten the process that GEI employed to select and design EPEMs appropriate for each individual property. The NOAF/NON assumes that SSDSs were categorically rejected as an option at the Site, and that GEI erroneously concluded that they “do not have utility for this Site.” That is clearly not the case. As of February 14, 2011, eight SSDSs had been installed and were operating at residential and commercial properties at the Site, not including the larger SSDSs installed at the Capuano Center, 50 Tufts Street (the Property), and 60 Tufts Street. “Active” systems were the first option considered for every property and were rejected only where building construction and other Site-specific conditions made successful installation of such systems infeasible. Data, observations, and experience gleaned from work at many, many properties at this Site have demonstrated that an SSDS frequently is not the optimal remedial option. For MassDEP to suggest that an SSDS is presumptively effective and feasible at this Site suggests a fundamental lack of understanding of the variety of subsurface conditions and building conditions documented in exhaustive evaluations and status reports previously filed for this Site and presented in some detail in the IRA Completion Report.

6. It is equally apparent from the NOAF/NON that MassDEP did not comprehend the basis for the determination of infeasibility reached for properties where only low levels of compounds of concern were detected in indoor air that were consistent with a condition of NSR. The NOAF/NON states, incorrectly, that GEI reached the determination that elimination or mitigation of a Critical Exposure Pathway (CEP) was infeasible based solely on the absence of a risk that exceeded a condition of NSR: "The requirement to eliminate, mitigate, or prevent a [CEP] applies regardless of the quantitative level of risk. Determination of a condition of NSR is not, in and of itself, sufficient justification to conclude that elimination or mitigation of a CEP is not feasible."

GEI did not assert it is infeasible to mitigate a CEP based solely on the demonstrated absence of significant risk. As stated in Section 2.4.1 and Table 2-1 of the IRA Completion Report, GEI developed reliable cost estimates for mitigating the vapor intrusion pathway for residences at the Site. These estimates were derived from actual costs incurred for comparable systems already installed at this Site. As stated in the IRA Completion Report, GEI used the estimates of costs and risks obtained from Site-specific data to answer the question "do the benefits of achieving a remedial endpoint outweigh the costs?" This is entirely consistent with the requirements of the Massachusetts Contingency Plan (MCP; 310 CMR 40.0860), and MassDEP policy on "Conducting Feasibility Evaluations under the MCP."

As stated on Page 10 of the IRA Completion Report, the results of that feasibility evaluation were as follows:

"For the homes at which a condition of NSR has been demonstrated through indoor air testing, installation of an EPEM (Option 1, 2 or 3) is infeasible. For homes where owners have been contacted and refused access, and DEP has been notified, installation of an EPEM cannot be accomplished and is infeasible. Regardless of which Option may apply, it has been demonstrated at this Site that the costs of *effective* mitigation measures to address the vapor intrusion pathway are substantial (\$75,000 to \$125,000). The incremental benefit, if indeed there is any such benefit, that such measures may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. By definition, implementing measures that are ineffective produces no benefit and therefore fails the feasibility analysis. Repeated trials at this Site – including initial sealing of visible cracks in floors on Tufts Street, provision of temporary air filtration systems, and implementation of "conventional" sub-slab systems that did not work due to subsurface and building conditions – have demonstrated that more limited measures are simply of no utility."

7. At two properties where EPEMs have been installed, at considerable expense, and have successfully mitigated indoor air concentrations to a condition of NSR, the NOAF/NON erroneously asserts that "CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted." Such a statement completely ignores the fact that a feasibility evaluation was completed *before* the EPEM was installed, and substantial costs have been incurred precisely for the purpose of mitigating the CEP "*to the extent feasible*." Any suggestion that potential additional mitigation measures should be evaluated for feasibility as if substantial cumulative costs had not already been expended is entirely at odds both with the facts and the MCP.

2. Disregard for Regulatory Context

From the NOAF/NON, it also appears that MassDEP was not fully familiar with the Site history and regulatory context based on which the IRA Completion Report was prepared. The NOAF/NON does not recognize, for example, that the Site has been in Phase IV since August 2009, or that remedial measures have continued to be implemented *as Phase IV activities* at the Site since submittal of the IRA Completion Report. Given MassDEP's disregard for the regulatory context, specifically within the chronology of investigations at this Site and generally within the MCP process as a whole, it is apparent that further explanation is warranted here.

GEI submitted the Phase II Comprehensive Site Assessment (CSA) and Phase III Evaluation of Remedial Alternatives (Phase II/Phase III) on July 16, 2008. The Phase IV Remedial Implementation Plan (RIP) was submitted on August 10, 2009. The IRA Completion Report was filed following submittal of the Phase IV RIP, in accordance with the MCP (310 CMR 40.0427). As provided for in the Phase IV, GEI continues to operate active remedial systems and perform other response actions, as necessary, as comprehensive response actions (CRAs). This, too, comports with the requirements of the MCP (310 CMR 40.0429).

The NOAF/NON focuses on only a small piece of the IRA Completion Report with respect to a few properties. The NOAF/NON treats the IRA Completion Report as if it occurred in a vacuum, and makes no mention of Phases II, III, and IV of the MCP process already completed at this Site. The NOAF/NON ignores the fundamental premise that the CEP requirements in the MCP ensure that timely action is taken, where feasible, to protect sensitive human receptors from exposures to site-related compounds in indoor air or drinking water, *while a disposal site is under investigation*. Likewise, the NOAF/NON ignores the explicit language in 310 CMR 40.0427(1)(c) that CEPs are to be eliminated or mitigated "pending the completion of a risk assessment pursuant to 310 CMR 40.0900 and a feasibility study pursuant to 310 CMR 40.0860."

Consistent with its overly narrow focus, the NOAF/NON oversimplifies the analysis and conclusions of the IRA Completion Report as to the feasibility of mitigating CEPs in instances where a condition of NSR already has been demonstrated through multiple rounds of sampling and repeated risk characterizations. As MassDEP itself stated at an early stage of investigations at this Site, the CEP feasibility equation balances the long-term cost of response actions needed to address the CEP with the benefit gained. Once the risks associated with the vapor intrusion pathway are known, and if they are determined to constitute a condition of NSR, then the feasibility equation tips away from continuing mitigation efforts. The NOAF/NON acknowledges neither the place of the IRA Completion Report in the final stages of the MCP process nor the impact that context has on the feasibility equation.

The CEP provisions of the MCP are included among requirements for IRAs (40.0414[3] and 40.0427[1][c]). Those provisions call for preliminary response actions to address exposures to potentially sensitive receptors pending more comprehensive evaluation of Site conditions and implementation of CRAs. Generally, IRAs are conducted prior to completing a Phase II and Risk Characterization, when the nature and the extent of a release and its associated potential risks are still under investigation, and prior to completion of the Phase III and Phase IV.

GEI systematically implemented preliminary response actions to identify and address CEPs, under an approved IRA Plan, pending completion of the Risk Characterization, the Phase III, and the Phase IV. GEI took timely actions to evaluate and address CEPs in residences and at the Capuano Center, and to evaluate and address the vapor intrusion pathway in commercial buildings. As discussed in the Phase II/Phase III and Phase IV RIP, the remedial alternative selected for the Site includes operation of the SSDS and Soil Vapor Extraction (SVE) system at the Property, implementation of EPEMs to address the vapor intrusion pathway and achieve NSR

in residences and commercial buildings beyond the Property boundaries, and Monitored Natural Attenuation (MNA).

310 CMR 40.0427(1)(c) states that an IRA shall be considered complete when the IRA condition has been assessed and remediated in a manner and to a degree that will ensure “the elimination, prevention or mitigation of Critical Exposure Pathway(s) without the continued operation and maintenance of active remedial systems, *pending the completion of a risk assessment pursuant to 310 CMR 40.0900 and a feasibility study pursuant to 310 CMR 40.086.*” (Emphasis added.) The emphasized clause cannot simply be ignored. The only way that clause makes sense is that the CEP standard applies “pending” completion of the Site investigation, risk assessment, and feasibility study.

At the time that the IRA Completion Report was filed, this Site was already in Phase IV. The Phase II/Phase III had been completed; the uncertainties about the Site including the nature and extent of contamination and the risks posed by the Site had been addressed. At that point, it was entirely appropriate to conclude that the IRA phase had ended, and that any requisite response actions previously implemented as IRAs would continue as CRAs.

3. Response to Asserted Violations

3.1 Violation: 310 CMR 40.0414(3) – Scope and Types of IRAs

310 CMR 40.0414(3)(b) and (c) state, in part, that IRAs shall be presumed to require elimination and/or mitigation of CEPs to the extent feasible.

In summary, the NOAF/NON contends that GEI incorrectly concluded it was infeasible to eliminate or mitigate a CEP at certain residences where indoor air concentrations were consistent with a condition of NSR. Under the same rubric, the NOAF/NON also asserts that the “effectiveness” of passive systems that already have been installed and have mitigated indoor air concentrations to a condition of NSR has not been demonstrated. As noted above, these assertions are based on fundamental errors of fact.

3.1.1 Infeasibility to Mitigate CEPs:

GEI disputes the assertions in the NOAF/NON that mitigation systems were not offered to the following properties, and that the feasibility of eliminating or mitigating the CEP at these properties was based solely on the quantitative level of risk:

- 105-107 Washington Street
- 111 Washington Street
- 23 Knowlton Street
- 6-8 Morton Street

3.1.1.1 105-107 Washington Street and 111 Washington Street

EPEMs were offered to the owners of 105-107 and 111 Washington Street and the owners refused. Copies of correspondence with the owners of 105-107 and 111 Washington Street are included in the IRA Completion Report Amendment (Attachment B). Given that access to install EPEMs has been denied, mitigating or eliminating CEPs in these buildings is infeasible.

3.1.1.2 23 Knowlton Street

Concentrations of PCE were measured in the basement at 23 Knowlton Street, but not on the first floor, at levels that constituted a condition of NSR. Initially, an EPEM was not recommended because, at that time, it was MassDEP's stated policy not to classify detections that occurred solely in unoccupied basements as CEPs. However, following the submittal of the Phase II/Phase III, MassDEP announced a change of policy in a Notice of Audit Findings dated January 20, 2009 (NOAF). That NOAF took the position that the detection of compounds of concern solely in unoccupied basements constituted a CEP regardless of the present use of basement space. As the present NOAF/NON acknowledges, MassDEP has since clarified that a basement is considered "living or working space" even if not presently used for such purposes provided that there is at least 7 feet of headroom.

The basement ceiling height at 23 Knowlton Street is less than 7 feet (6'9"). The basement is used for storage only, and there is no evidence that the basement is used as living or working space. Consistent with current MassDEP guidance, since PCE has only been detected in the basement, a CEP does not exist at 23 Knowlton. In addition, because exposure to concentrations of PCE detected in indoor air at 23 Knowlton Street constitute a condition of NSR for building occupants, mitigation or other response actions are not required.

3.1.1.3 6-8 Morton Street

Concentrations of PCE were measured in the basement at 6-8 Morton Street, but not on the first floor, at levels that constituted a condition of NSR. Initially, an EPEM was not recommended because, at that time, it was MassDEP's stated policy not to classify detections that occurred solely in unoccupied basements as CEPs. However, following the submittal of the Phase II/Phase III, MassDEP announced a change of policy in a Notice of Audit Findings dated January 20, 2009 (NOAF). That NOAF took the position that the detection of compounds of concern solely in unoccupied basements constituted a CEP regardless of the present use of basement space. As the present NOAF/NON acknowledges, MassDEP has since clarified that a basement is considered "living or working space" even if not presently used for such purposes provided that there is at least 7 feet of headroom.

Following the revision of the CEP definition by MassDEP, GEI conducted a feasibility evaluation for eliminating or mitigating a CEP which posed NSR at 6-8 Morton Street. Due to building age, construction details, and poor sub-slab communication, the cost of implementing a mitigation system at 6-8 Morton Street that would further reduce already low indoor air concentrations measured in the basement would be prohibitive – many times the \$5,000 estimated cost that MassDEP has said it used as a benchmark for "presumptive feasibility" of SSDSs for retrofitted CEP mitigation measures.

The incremental benefit, if indeed there is any such benefit, that such measures may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Furthermore, as noted above, once the risks associated with the vapor intrusion pathway are known, and if they are determined to constitute a condition of NSR, then the feasibility equation tips away from mitigation efforts.

3.1.2 EPEM Effectiveness

GEI disputes the assertion in the NOAF/NON that the effectiveness of passive mitigation systems at the following properties has not been demonstrated, and that the CEPs have not been mitigated to the extent feasible:

- 4 Morton Street
- 17 Knowlton Street
- 27 Tufts Street

These are properties where EPEMs were installed, and PCE has been detected in one or more post-mitigation indoor air sampling rounds.

As noted in previous filings, including the IRA Completion Report, the objectives of the EPEMs are to:

- Eliminate or mitigate, to the extent feasible, the potential soil vapor migration pathway to indoor air in residential buildings.
- Achieve a condition of NSR for occupants of the residence or commercial building.

3.1.2.1 4 Morton Street

Installation of an Option 3 EPEM was completed in December 2008, and based on post-installation indoor air results, the EPEM was modified in August 2009. PCE was detected in post-modification samples in the basement, but not on the first floor.

Similar to 23 Knowlton Street, the basement ceiling height at 4 Morton Street is less than 7 feet (6'4"). The basement is used for storage only, and there is no evidence that the basement is used as living or working space. Consistent with current MassDEP guidance, since PCE has only been detected in the basement, the CEP has been eliminated at 4 Morton Street. In addition, because exposure to concentrations of PCE detected in indoor air at 4 Morton Street constitute a condition of NSR for building occupants, additional response actions are not required.

3.1.2.2 17 Knowlton Street and 27 Tufts Street

MassDEP has stated that the effectiveness of the passive EPEMs at 17 Knowlton Street and 27 Tufts Street has not been demonstrated, based on a review of the data presented in the IRA Completion Report. Basement indoor air concentrations at 17 Knowlton Street and 27 Tufts Street have been reduced from a maximum of 2.7 $\mu\text{g}/\text{m}^3$ and 117 $\mu\text{g}/\text{m}^3$, respectively, to less than laboratory reporting limits. MassDEP points out that in addition to non-detects, concentrations greater than the laboratory reporting limits have also been measured in these residences following the installation of the passive EPEMs. Concentrations as high as 1.6 $\mu\text{g}/\text{m}^3$ (17 Knowlton Street) and 1.8 $\mu\text{g}/\text{m}^3$ (27 Tufts Street) have been measured. These concentrations barely exceed laboratory reporting limits and constitute a condition of NSR.

In the NOAF/NON, the passive EPEM effectiveness is compared to that of active systems at 95R Franklin Street, 13 Knowlton Street, 31-33 Knowlton Street, and 23 Tufts Street, where concentrations as high as 106 $\mu\text{g}/\text{m}^3$, 6 $\mu\text{g}/\text{m}^3$, 33 $\mu\text{g}/\text{m}^3$, 125 $\mu\text{g}/\text{m}^3$ were also reduced to less than laboratory reporting limits. Similar to the residences where passive systems were installed, however, concentrations greater than laboratory reporting limits also have been measured following the installation of active SSDSs. In addition, as stated previously, the reduction in indoor air concentrations presented for 95R Franklin Street is representative of the passive system installed at the property, not an SSDS.

Based on the active systems referred to by MassDEP in the NOAF/NON, it is clear that the passive EPEMs have demonstrated comparable, if not superior, effectiveness in reducing indoor air concentrations. Based on the most recent Risk Characterization and exposure durations of 12 hours on the first floor and 12 hours in the basement, the EPEMs installed at 17 Knowlton Street

and 27 Tufts Street have reduced the concentrations of VOCs in indoor air to below those that constitute a condition of NSR. MassDEP simply is not correct that, at this Site, active systems are presumptively more effective than passive EPEMs. The data show that different systems are appropriate for different property conditions and, once properly installed, the passive systems are no less effective than the active ones.

Sampling results consistently demonstrate that the EPEMs have been successful both in achieving a condition of NSR and in mitigating CEPs to the extent feasible. That compounds of concern have been mitigated at substantial cost but not completely eliminated is entirely consistent with the MCP (310 CMR 40.0414[3]). The suggestion in the NOAF/NON that “CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted” is inconsistent with both Site data and the MCP. First, as noted above, such a suggestion entirely ignores the substantial cumulative costs already incurred to mitigate CEPs. Second, GEI evaluated the cost associated with converting these passive systems to active ones; operating an SSDS with ongoing MCP oversight and submittal costs is substantial, and the incremental benefit (if indeed there is any such benefit) in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost.

The CEPs at these properties in fact have been mitigated to the extent feasible.

3.2 Violation: 310 CMR 40.0993(4) – Estimates of Potential Exposure

The NON states “MassDEP assumes that a basement with 7 feet of headroom could potentially be used as a bedroom and therefore could be occupied by a receptor for up to 12 hours per day.”

AMEC Earth & Environmental (AMEC) of Westford, Massachusetts has already submitted, on UniFirst’s behalf, three comprehensive Method 3 Risk Characterizations for the Site. The first was submitted as part of the Phase II/Phase III in July of 2008. The second, a Supplemental Method 3 Risk Characterization, was submitted in May 2009 to respond to comments from MassDEP. In support of the IRA Completion Report submitted in November 2009, AMEC completed a third Revised Supplemental Method 3 Risk Characterization that incorporated data collected at the Site through September 30, 2009. These multiple risk characterizations reflect and address MassDEP’s evolving policies concerning evaluation of the vapor intrusion pathway.

The NOAF/NON requests preparation of a fourth Risk Characterization based on two more recent changes in MassDEP policy: (1) use of exposure durations of 12 hours on the first floor and 12 hours in the basement (rather than 20 and 4 hours, respectively, as provided for in existing MassDEP guidance (WSC Policy #02-430); and (2) an assumption that any basement with at least 7 feet of headroom in an occupied residential dwelling be treated as existing “living or working space.”

Previous Risk Characterizations assumed an exposure duration of 4 hours in residential basements not presently used as living quarters. This was consistent both with current MassDEP guidance and conditions observed at these properties. Many were constructed more than 100 years ago and evidence suggests that in all this time the basements have not been used as bedrooms. Considering historic use, and current zoning and permitting requirements, it is unlikely that these basements will be converted to bedrooms in the foreseeable future. Particularly in urban areas, zoning ordinances and building codes typically prohibit renovation of basements for living space, at least absent a separate route of egress in case of fire. Therefore, 4 hours was identified as a reasonably conservative estimate of basement exposure under current and future conditions.

To meet the recommendation made in the NOAF/NON, however, ARCADIS U.S., Inc. (ARCADIS) of Chelmsford, Massachusetts has prepared an Updated Revised Supplemental Risk Characterization, included as Attachment C, in accordance with the exposure duration assumptions set forth under Required Action No. 2. Based on the revised risk calculations, a condition of NSR does not exist at four residential properties that have not been previously mitigated (the right unit of 9 Tufts Street, 17 Tufts Street, 19 Tufts Street, and, with respect to potential cumulative indoor/outdoor risks to a future resident, at 105-107 Washington Street). The owners of each one of these properties has refused mitigation.

4. Required Actions

4.1 IRA Modification Plan to Eliminate or Mitigate CEPs

In the NOAF/NON, MassDEP has requested that an IRA Plan Modification be submitted by April 2, 2011. In lieu of an IRA Plan Modification, GEI is submitting an IRA Completion Report Amendment (Attachment B) further documenting that all CEPs have been “eliminated or mitigated to the extent feasible.” In summary, each residence called out in the NOAF/NON has been addressed as follows:

Address	Outcome
17 Knowlton Street	Infeasible based on site-specific estimates of costs to reduce concentrations beyond NSR.
23 Knowlton Street	Ceiling in basement less than 7 feet, not a CEP, and low concentrations constitute a condition of NSR.
4 Morton Street	Ceiling in basement less than 7 feet, not a CEP, and low concentrations constitute a condition of NSR.
6-8 Morton Street	Infeasible based on site-specific estimates of costs to reduce concentrations beyond NSR.
27 Tufts Street	Infeasible based on site-specific estimates of costs to reduce concentrations beyond NSR.
105-107 Washington Street	Infeasible because property owner has denied access.
111 Washington Street	Infeasible because property owner has denied access and low concentrations constitute a condition of NSR.

4.2 Updated Revised Supplemental Risk Characterization

As requested, an Updated Revised Supplemental Risk Characterization, prepared in accordance with the recommendations set forth under Required Action No. 2 in the NON/NOAF, is included as Attachment C.¹ As stated in the attached Risk Characterization, however, based on observations of existing and historical property conditions and applicable land use restrictions, we continue to deny that it is reasonably foreseeable either that residents will spend 12 hours per day in these basements or that they will be redeveloped in the future for use as bedrooms.

¹ The NOAF/NON required submission of “[a]n updated Risk Characterization ... for all residences impacted by vapor intrusion.” The Updated Revised Supplemental Risk Characterization included as Attachment C therefore addresses all residences at the Site impacted by vapor intrusion. The IRA Completion Report Amendment included as Attachment B addresses those properties, namely those properties specifically referenced in the NON/NOAF and, as noted in Section 4.3 below, additional properties that MassDEP may consider to be situated similarly to those identified in the NOAF/NON based on data collected since the IRA Completion Report.

4.3 Implementation of IRAs to Eliminate or Mitigate All CEPs

In the NOAF/NON, MassDEP directed UniFirst to "continue to implement Immediate Response Actions at the Site in compliance with the MCP until you can document that all CEPs have been eliminated or mitigated to the extent feasible."

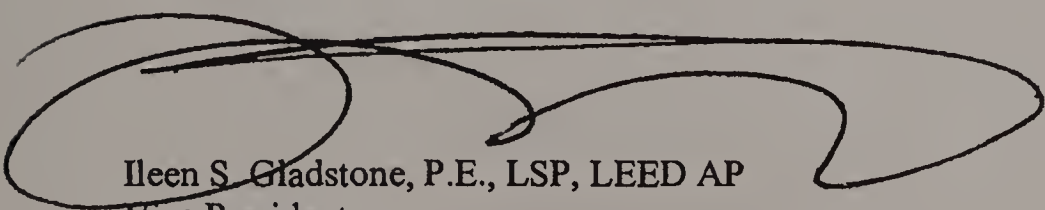
In addition to clarifying that the CEPs in the residences explicitly cited in the NOAF/NON do not exist or have been eliminated or mitigated to the extent feasible, in an effort to achieve finality, GEI evaluated properties that MassDEP may consider to be situated similarly to those identified in the NOAF/NON based on data collected since the IRA Completion Report. This evaluation is presented in the IRA Completion Report Amendment.

The information provided in the IRA Completion Report, the IRA Completion Report Amendment (included as Attachment B to this response), and the Updated Revised Method 3 Risk Characterization (included as Attachment C to this response), fully documents that the requirements of 310 CMR 40.0427(1) have been met. IRAs have been completed. We will continue to conduct comprehensive response actions under the Phase IV RIP.

For the reasons stated above and in the extensive reports attached to this response, we submit that the NOAF/NON contains multiple factual, technical, and legal errors. Each alleged instance of non-compliance is simply without foundation. In the interests of finality, UniFirst has directed GEI and ARCADIS to expand and update the IRA Completion Report and Risk Characterization to address head-on each concern raised in the NOAF/NON. In the event that the Northeast Regional Office concludes, after reading this response and its attachments, that any part of the NOAF/NON remains unresolved, then UniFirst requests a meeting be convened with Assistant Commissioner Commerford to discuss any remaining concerns.

Sincerely,

GEI CONSULTANTS, INC.



Ileen S. Gladstone, P.E., LSP, LEED AP
Vice President

ISG:csh

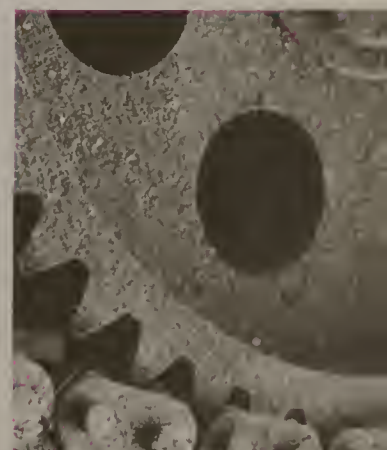
Enclosure

c: John R. Badey, UniFirst Corporation
Vithal V. Deshpande, City of Somerville
Janine Commerford, MassDEP
Andrew Freidman, MassDEP via eDEP

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Attachment A

**NOAF/NON (NON-NE-11-3S004) and Audit Memorandum from
MassDEP dated February 1, 2011**



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

Certified Mail

February 1, 2011

Unifirst Corporation
68 Jonspin Road
Wilmington, MA 01887
ATTN: Mr. John R. Badey

RE: Somerville
50 Tufts Street
RTN 3-23246
IRAC Invalidation
NON-NE-11-3S004

**NOTICE OF AUDIT FINDINGS
NOTICE OF NONCOMPLIANCE
IMMEDIATE RESPONSE ACTION COMPLETION STATEMENT NOT VALID**

Dear Mr. Badey:

The Massachusetts Department of Environmental Protection (MassDEP) has conducted an audit of the Immediate Response Action Completion statement (IRAC) filed for the above-referenced site (the Site), which is identified by Release Tracking Number 3-23246. The IRAC Statement, received on November 16, 2009, was prepared on your behalf (as used in this Notice, "you" refers to UniFirst Corporation) by GEI Consultants, Inc. (GEI), Ileen Gladstone, LSP #9719.

FINDINGS

IRAC Not Valid As a result of the audit, MassDEP has determined that response actions were not performed in compliance with the requirements of the Massachusetts Contingency Plan (MCP) and, therefore, the IRAC submittal is not valid. Violations were identified that require additional actions to be taken under the supervision of an LSP in order to come into compliance with the MCP.

The Notice of Noncompliance (Attachment A) describes: (1) each activity identified during the audit which is in noncompliance, (2) the requirements violated, (3) the actions MassDEP now wants you to take, and (4) the deadlines for taking these actions.

The Audit Memorandum (Attachment B) describes the activities MassDEP personnel performed during the audit and summarizes relevant site information.

You do not need further MassDEP approval to take the actions MassDEP has specified.

LICENSED SITE PROFESSIONAL

A copy of this Notice has been sent to Ileen Gladstone (LSP #9719). Please note that you, not your LSP, are responsible for responding to this Notice of Noncompliance and correcting the violations identified herein.

LIMITATIONS

MassDEP's findings were based upon the certainty of the information reviewed during the audit. These findings do not: (1) apply to actions or other aspects of the site that were not reviewed in the audit, (2) preclude future audits of past, current, or future actions at the site, (3) in any way constitute a release from any liability, obligation, action or penalty under M.G.L. c. 21E, 310 CMR 40.0000, or any other law, regulation, or requirement, or (4) limit the MassDEP's authority to take or arrange, or to require any Responsible Party or Potentially Responsible Party to perform, any response action authorized by M.G.L. c. 21E which the MassDEP deems necessary to protect health, safety, public welfare, or the environment.

If you have any questions regarding this Notice, contact Andrew Friedmann at (978) 694-3217. Please reference the Release Tracking Number 3-23246 in any future correspondence to MassDEP regarding the site.

Sincerely,

This electronic copy is being provided as a cost-saving measure. A signed final version of this document is available for review at the Department.

e-signature

Stephen M. Johnson

Stephen M. Johnson
Deputy Regional Director
Bureau of Waste Site Cleanup

Cc: Data Entry, AUDCOM/NAFNON/IRA/INVSUB
Cc: (electronically): Somerville Board of Health
Ileen Gladstone, LSP (igladstone@geiconsultants.com)

Attachments A: Notice of Noncompliance
B: Audit Memorandum

Attachment A

NOTICE OF NONCOMPLIANCE

Somerville – 50 Tufts Street RTN 3-23246

PERSON/ENTITY IN NONCOMPLIANCE

Unifirst Corporation, 68 Jonspin Road, Wilmington, MA

LOCATION WHERE NONCOMPLIANCE OCCURRED OR WAS OBSERVED

50 Tufts Street, Somerville, MA

DATE WHEN NONCOMPLIANCE OCCURRED OR WAS OBSERVED

November 16, 2009, the receipt date of the Immediate Response Action Completion (IRAC) Statement

DESCRIPTION OF REQUIREMENTS NOT COMPLIED WITH

1. Violation: 310 CMR 40.0414(3) – Scope and Types of Immediate Response Actions

310 CMR 40.0414(3)(b) and (c) state, in part, that Immediate Response Actions shall be presumed to require the elimination and/or mitigation of Critical Exposure Pathways (CEPs) to the extent feasible.

Several residential properties have CEPs that have not been eliminated or mitigated to the extent feasible, either because a mitigation system was not offered or the mitigation system that was installed has not been demonstrated to be effective.

GEI asserted that it is infeasible to mitigate a CEP when the indoor air contaminant levels are consistent with a condition of No Significant Risk. Based on this assertion, mitigation systems were not offered to the following four residential buildings:

- 23 Knowlton Street;
- 6-8 Morton Street;
- 105-107 Washington Street; and
- 111 Washington Street.

The requirement to eliminate, mitigate or prevent a CEP applies regardless of the quantitative level of risk. Determination of a condition of NSR is not, in and of itself, sufficient justification to conclude that elimination or mitigation of a CEP is not feasible.

In addition to the buildings listed above, the effectiveness of passive mitigation systems in the residential buildings listed below has not been demonstrated:

- 17 Knowlton Street;
- 4 Morton Street; and
- 27 Tufts Street.

For these residences, PCE has been detected in indoor air in one or more post-mitigation sampling rounds. The presence of PCE indicates the CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted.

2. Violation: 310 CMR 40.0993 (4) – Estimates of Potential Exposure

Per 310 CMR 40.0993(4), the magnitude of each receptor's total exposure to the oil and/or hazardous material at the disposal site is calculated in a manner which provides a conservative estimate of the potential exposures.

MassDEP assumes that a basement with 7 feet of headroom could potentially be used as a bedroom and therefore could be occupied by a receptor for up to twelve hours per day. The risk assessment used to support the IRAC (Appendix C of the IRAC Statement) assumed an exposure duration in the basement of four hours. This exposure assumption does not provide a conservative estimate for unrestricted use and cannot be used to support a conclusion of No Significant Risk.

ADDITIONAL COMMENT

Due to the relatively low cost of SSD systems, MassDEP considers installation of these systems feasible to mitigate or eliminate most CEP conditions caused by vapor intrusion. GEI has concluded that repeated trials at the site have demonstrated that conventional SSD systems have no utility. However, the pre- and post-mitigation indoor air data from on-site buildings that received conventional SSD systems indicate that the systems are effective in reducing or eliminating vapor intrusion (Table 1 in the Audit Memorandum).

DESCRIPTION OF REQUIRED ACTIONS

MassDEP hereby notifies you that the following response actions are necessary in order to bring the site back into compliance with the MCP:

1. An Immediate Response Action Plan Modification must be submitted within 60 days of the date of this letter and must include plans to eliminate or mitigate to the extent feasible CEPs at the following residences:
 - 17 Knowlton Street;
 - 23 Knowlton Street;
 - 4 Morton Street;
 - 6-8 Morton Street;
 - 27 Tufts Street;
 - 105-107 Washington Street; and
 - 111 Washington Street.

This plan should include a schedule of work to be done for each residence, and a schedule for additional indoor air sampling where needed.

As noted previously, in most cases MassDEP recommends the use of SSD systems to mitigate vapor intrusion. Prior to system installation, subslab quantitative diagnostic air flow and pressure testing can be used determine the most effective design for each building.

If a SSD system is installed, the primary performance standards used to confirm system effectiveness are the demonstration of a negative pressure field under the slab and the comparison of air sampling data collected before and after system installation.

2. An updated Risk Characterization must be submitted within 60 days of this letter for all residences impacted by vapor intrusion.

In order to demonstrate No Significant Risk for residential use, the appropriate exposure assumptions used in calculating an average daily exposure should be continuous exposure (24 hours per day, 365 days per year, for 30 years). These assumptions address the homebound adult and unrestricted use of the residence. If more than one EPC is developed for a building, such as an EPC for the basement and an EPC for the first floor, the exposure durations can be subdivided accordingly in order to estimate a time-weighted average daily dose. For residences, MassDEP recommends assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors, provided there is sufficient data to develop location-specific EPCs.

3. You must continue to implement Immediate Response Actions at the Site in compliance with the MCP until you can document that all CEPs have been eliminated or mitigated to the extent feasible.
4. After completion of these required activities, submit a Post-Audit Completion Statement, in accordance with 310 CMR 40.1170, to the MassDEP and to the attention of Andrew Friedmann. A copy of the Post-Audit Completion Statement is available at <http://mass.gov/dep/cleanup/approvals/trforms.htm>.

Attachment B

AUDIT MEMORANDUM

I. AUDIT ACTIVITIES

The audit consisted of the following activities:

- A review of the Immediate Response Action Completion Statement, received November 16, 2009 and other information in the MassDEP files.

II. SITE SUMMARY

The Site includes the 50 Tufts Street property (the Property), residential and commercial properties in the neighborhood to the east and west of the Property, and the Michael E. Capuano Early Childhood Center (Capuano Center). An approximately 20,594 ft² one-story building is located at 50 Tufts Street. The release of chlorinated volatile organic compounds (VOCs) into soil and groundwater is associated with the former use of this building as a dry cleaning supply repackaging and distribution facility. The facility operated from approximately 1955 through 2002.

The highest concentrations of chlorinated VOCs are located at 50 Tufts Street. Up to 52,000 ug/L of tetrachloroethylene (PCE), 220,000 ug/L trichloroethylene (TCE) and 290,000 ug/L 1,1,1-trichloroethane (TCA) were found in groundwater on the property. Groundwater depth at the site ranges from approximately 8.5 feet to 13 feet below ground surface. Overburden groundwater flow is toward the southeast.

Unifirst Corporation received a Notice of Responsibility from MassDEP dated November 9, 2005, and has been conducting response actions since March, 2006. In the NOR, MassDEP required an Immediate Response Action due to the detection of contamination near residential structures.

Immediate Response Actions

Response actions have included investigations into the nature and extent of contamination in groundwater, soil, soil gas, and indoor air at the 50 Tufts Street property, at 113 residences and commercial properties located in the neighborhood over the groundwater plume and at the Capuano Early Childhood Center.

GEI developed three remedial options to eliminate/mitigate vapor intrusion into the homes and businesses associated with the Tufts Street site:

- Option 1 is a conventional Sub-Slab Depressurization (SSD) system. These system follow a design similar to those commonly used for vapor mitigation. Sub-slab

vapors are pulled through a piping network by an in-line fan and discharged from an exhaust pipe above the roofline;

- Option 2 is a passive system with a vapor trench. This option is installed when there is a fieldstone or brick foundation, and poor sub-slab air flow. Option 2 consists of sealing the foundation walls with a vapor barrier system, installing a vapor trench around the basement perimeter, and sealing the floor with epoxy. A piping network connects the trench to an exhaust pipe above the roofline; and
- Option 3 is a passive system with the installation of a new floor. This option is installed for buildings with an incompetent concrete floor, fieldstone or brick foundation, and poor sub-slab air flow. Foundation walls are sealed with a vapor barrier system. The floor is removed, vapor sump systems are installed, and a new concrete floor is poured and sealed. Sub-slab pipes are connected to a piping network that discharges through a pipe above the roofline.

To date, vapor mitigation systems have been installed at 19 properties with a confirmed or likely Condition of Substantial Release Migration (SRM). Currently, eleven of these systems are passive and eight are active. The effectiveness of the active systems was assessed with between 1 and 7 rounds of indoor air testing, as well as the measurement of a negative pressure in the sub-slab relative to the indoor air. The effectiveness of the passive systems was assessed with between 1 and 5 rounds of indoor air testing.

Mitigation systems have not been installed in several of the buildings with SRM conditions. The IRAC stated that mitigation systems were not necessary in these buildings because a risk characterization performed by AMEC Earth and Environmental (AMEC) concluded a Condition of No Significant Risk exists or is likely to exist (dependent upon confirmatory indoor air sampling) at each location.

The Method 3 Risk Characterization performed by AMEC used both temporal and spatial averaging to estimate Exposure Point Concentrations (EPCs) for residences. For residences where 3 or more indoor air sampling rounds had been completed, the average value was used for the EPC. If there were fewer than 3 sampling rounds, the maximum detected value was used as the EPC. If a Contaminant of Potential Concern was not detected in the building, one-half the lowest laboratory reporting limit was used as the EPC. The time weighted average used to calculate the EPCs assumed 20 hours on the first floor and 4 hours in the basement.

Pre- and post-installation indoor air data is available from four on-site homes where “conventional” SSD systems were installed (Table 1). The data indicates these systems were effective at either mitigating or eliminating vapor intrusion.

Table 1
Concentrations of PCE ($\mu\text{g}/\text{m}^3$) in Basement Air of Homes with Conventional SSD Systems.

Address	Pre-SSDS Levels	Sampling Rounds	Post SSDS Levels	Sampling Rounds
95R Franklin Street	106	1	1.3 – 3.5	2
13 Knowlton Street	ND-6	2	ND	1
31-33 Knowlton Street	3-33	2	ND – 4.9	6
23 Tufts Street	2.3 – 125	6	ND – 1.4	5

In each of the above buildings, SSD systems appear to have significantly reduced the maximum concentration of PCE in indoor air. These data do not support the assertion that conventional SSD systems do not have “utility” for this site.

III. RISK ASSESSMENT

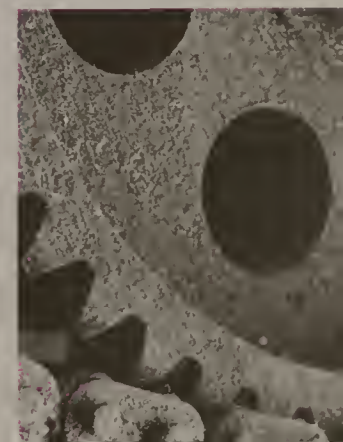
A Method 3 risk assessment was performed to estimate risks associated with exposure to contaminants of concern in soil, groundwater and indoor air. The risk assessment concluded that a Condition of No Significant Risk exists at 16 residential properties for both current and future unrestricted use. This conclusion is based on an assumed 4 hours per day exposure in residential basements.

IV. DETERMINATION

On the basis of the activities performed during the audit and in reliance upon the accuracy of that information, MassDEP makes the Determination that violations of the MCP were found in the actions audited, as outlined in Attachment A.



Geotechnical
Environmental
Water Resources
Ecological



Attachment B

IRA Completion Report Amendment



Geotechnical
Environmental and
Water Resources
Engineering

MassDEP RTN 3-23246

Immediate Response Action Completion Report Amendment

50 Tufts Street, Somerville, Massachusetts

Submitted to:

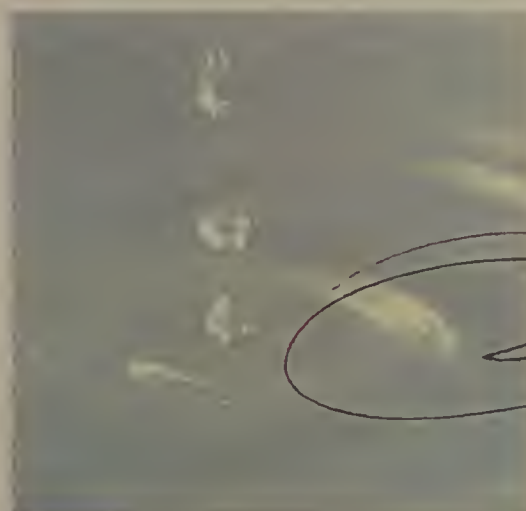
UniFirst Corporation
68 Jonspin Road
Wilmington, MA 01887

Submitted by:

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801
781.721.4000

April 1, 2011

Project 04516-3



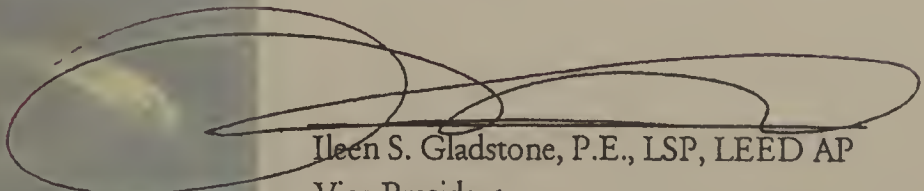

Ileen S. Gladstone, P.E., LSP, LEED AP
Vice President

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Abbreviations and Acronyms

µg/L.....	micrograms per liter
µg/m ³	micrograms per cubic meter
CEP	Critical Exposure Pathway
CRA	Comprehensive Response Action
DNAPL	dense non-aqueous phase liquid
EPEM.....	Exposure Pathway Elimination Measure
ft ²	square foot/feet
HP	horsepower
IRA.....	Immediate Response Action
LSP.....	Licensed Site Professional
MassDEP.....	Massachusetts Department of Environmental Protection
MBTA	Massachusetts Bay Transportation Authority
MCP	Massachusetts Contingency Plan
MNA	Monitored Natural Attenuation
NOAF.....	Notice of Audit Findings
NON.....	Notice of Non-Compliance
NSR.....	No Significant Risk
PCE	tetrachloroethylene (perchloroethylene)
PID	photoionization detector
RAO	Response Action Outcome
RAP	Release Abatement Plan
RIP	Remedy Implementation Plan
RMR.....	Remedial Monitoring Report
ROS.....	Remedy Operation Status
RTN.....	Release Tracking Number
SSDS	sub-slab depressurization system
SVE.....	soil vapor extraction
TCA.....	1,1,1-trichloroethane
TV	Threshold Value
VOC	volatile organic compound

Executive Summary

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, GEI Consultants, Inc. (GEI) prepared this Immediate Response Action (IRA) Completion Report Amendment to address issues that the Massachusetts Department of Environmental Protection (MassDEP) raised in a Notice of Audit Findings and Notice of Noncompliance (NOAF/NON) dated February 1, 2011 concerning IRA Completion Report and Remedial Monitoring Report (RMR) No. 11 (IRA Completion Report) submitted for the 50 Tufts Street site (Site) on November 13, 2009.

The Site includes the 50 Tufts Street property (the Property), residential and commercial properties in the neighborhood to the east and west of the Property, and the Michael E. Capuano Early Childhood Center (Capuano Center). Chlorinated volatile organic compounds (VOCs), particularly tetrachloroethylene (also called perchloroethylene [PCE]), have been measured in soil, groundwater, soil vapor, and indoor air at the Site.

The Site has been in Phase IV since August 2009. GEI submitted the Phase II Comprehensive Site Assessment (CSA) and Phase III Evaluation of Remedial Alternatives (Phase II/Phase III) on July 16, 2008. The Phase IV Remedial Implementation Plan (RIP) was submitted on August 10, 2009. As discussed in the Phase II/Phase III and Phase IV RIP, the remedial alternative selected for the Site includes operation of a soil vapor extraction (SVE) system on the Property, implementation and maintenance of Exposure Pathway Elimination Measures (EPEMs) to mitigate complete vapor intrusion pathways, and Monitored Natural Attenuation (MNA) for groundwater. The IRA Completion Report was filed following submittal of the Phase IV RIP, in accordance with the Massachusetts Contingency Plan (MCP; 310 CMR 40.0427).

In the NOAF/NON, MassDEP has announced that it “recommends assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors” for any basement that has at least 7 feet of headroom, without regard to its actual present use. This recommendation is at odds with existing MassDEP risk characterization guidance, and with actual and foreseeable property uses. Nonetheless, with this IRA Completion Report Amendment, GEI also is submitting an Updated Revised Supplemental Method 3 Risk Characterization prepared by ARCADIS U.S., Inc. (ARCADIS). That Report reflects the exposure assumptions that MassDEP requested in its NOAF/NON and data collection and EPEM modification measures completed by GEI as of February 14, 2011. The Updated Revised Supplemental Method 3 Risk Characterization again concludes that a condition of No Significant Risk (NSR) exists for all residential properties except for four residences

(only one of which is listed in the NOAF/NON) for which access to implement EPEMs has been denied.

In the NOAF/NON, MassDEP challenged the adequacy of GEI's determinations in the IRA Completion Report that IRAs were complete with respect to a subset of seven properties.

The NOAF/NON listed four residential properties where, according to MassDEP, mitigation systems were not, but should have been, offered. For each of these properties, as well as other properties with similar characteristics, that were not identified in the NOAF/NON, GEI conducted a property-specific study of the feasibility of eliminating or mitigating the Critical Exposure Pathway (CEP). The results are provided in Sections 3 and 4 of this IRA Completion Report Amendment. Specifically, with respect to the four residential properties identified in the NOAF/NON, EPEMs were either not feasible or not required at these properties because:

- Mitigation systems, in fact, were offered and refused by owners of two properties, 105-107 Washington Street and 111 Washington Street;
- Headroom in the unoccupied basement at one property, 23 Knowlton Street, is less than 7 feet, and chlorinated VOCs have not been detected on the first floor, so there never was an IRA condition; and
- Due to building age, construction details, and poor sub-slab communication, the cost of implementing an EPEM at the fourth property, 6-8 Morton Street, that would further reduce already low concentrations measured in the basement would be prohibitive – many times the \$5,000 estimated cost that MassDEP has said it used as a benchmark for “presumptive feasibility” of sub-slab depressurization systems (SSDSs) for retrofitted CEP mitigation measures.

MassDEP identified three other properties in the NOAF/NON at which EPEMs have been installed that have not entirely eliminated the CEP: 17 Knowlton Street, 27 Tufts Street, and 4 Morton Street. Headroom in the unoccupied basement at 4 Morton is less than 7 feet, and chlorinated VOCs have not been detected on the first floor since the EPEM was installed, so there is no CEP. In addition, the EPEM has been successful in achieving a condition of NSR.

With respect to the remaining two properties, sampling results consistently demonstrate that the EPEMs have been successful both in achieving a condition of NSR and in mitigating CEPs to the extent feasible. That compounds of concern have been mitigated at substantial cost but not completely eliminated is entirely consistent with the MCP (310 CMR 40.0414[3]). The suggestion in the NOAF/NON that “CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted” is inconsistent with both Site data and the MCP. The

MCP does not require that a new feasibility evaluation be conducted each time that remedial measures have been implemented without regard to the costs already incurred to implement such measures.

This IRA Completion Report Amendment is being submitted in lieu of an IRA Plan Modification since the CEPs at the properties identified in the NOAF/NON have been eliminated or mitigated to the extent feasible (310 CMR 40.0414[3] and [4]), in conformance with the requirements of the MCP, and operation and maintenance of installed EPEMs are being continued as Comprehensive Response Actions (CRAs). The Phase II/Phase III evaluations have been completed for the Site and a Phase IV RIP is being implemented. The IRA has been closed in accordance with the MCP (310 CMR 40.027). CRAs will continue to be performed as Phase IV activities for the Site (310 CMR 40.029), in accordance with the Phase IV RIP.

1. Introduction

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, GEI Consultants, Inc. prepared this Immediate Response Action (IRA) Completion Report Amendment for the site identified as 50 Tufts Street in Somerville, Massachusetts (the Site; Fig. 1-1). The Site includes the 50 Tufts Street property (the Property), properties in the neighborhoods east and immediately west of the Property, and the Michael E. Capuano Early Childhood Center (Capuano Center) located at 150 Glen Street (Fig. 1-2).

GEI submitted “IRA Completion Report and Remedial Monitoring Report (RMR) No. 11” (IRA Completion Report) to the Massachusetts Department of Environmental Protection (MassDEP) on November 13, 2009. The MassDEP issued to UniFirst a Notice of Audit Findings and Notice of Noncompliance (NOAF/NON) (NON-NE-11-3S004) dated February 1, 2011. A copy is provided in Appendix A. The information provided in this report addresses the request for additional information for individual properties identified in Required Action No. 1 and 3 in the NON. With this Report, GEI also is submitting an Updated Revised Supplemental Method 3 Risk Characterization prepared by ARCADIS U.S., Inc. (ARCADIS) that addresses the request for additional information in Required Action No. 2 of the NON.

1.1 Background

1.1.1 Regulatory Submittals

For tracking and reporting purposes, MassDEP Release Tracking Numbers (RTNs) for this Site have been consolidated under one number, RTN 3-23246. The IRA Plan associated with RTN 3-23246 was submitted to MassDEP on January 9, 2006. The Site is currently classified as Tier IC (Permit No. W085813).

Chlorinated volatile organic compounds (VOCs), particularly tetrachloroethylene (also called perchloroethylene [PCE]), have been detected in soil, groundwater (shallow and deep overburden, and bedrock), soil vapor, and indoor air at portions of the Site. The detection of chlorinated VOCs in indoor air at some buildings required the implementation of an IRA. IRA activities by UniFirst began at the Site in March 2006 and primarily included:

- Conducting Site-wide indoor air and subsurface sampling and testing;
- Mitigating vapor intrusion pathways resulting in measurable concentrations of chlorinated VOCs above laboratory reporting limits in living or working spaces in occupied residences and at the Capuano Center (a condition defined as a Critical

Exposure Pathway [CEP] in the Massachusetts Contingency Plan [MCP]), if feasible;
and

- Mitigating vapor intrusion pathways resulting in concentrations of chlorinated VOCs measured in indoor air at commercial buildings above those that would constitute a condition of No Significant Risk (NSR), based on a Method 3 Risk Characterization.

A detailed description of the Site, the history of releases, and the response actions conducted at the Site was presented in previously submitted reports. A list of previous regulatory submittals to MassDEP that document IRA and Comprehensive Response Actions (CRAs) at the Site by UniFirst (since January 2006) is presented in Table 1-1.

The “Phase II Comprehensive Site Assessment (CSA), Method 3 Risk Characterization, and Phase III Remedial Action Plan (RAP)” (Phase II/Phase III) for the Site was submitted to MassDEP on July 14, 2008. The “Phase IV Remedy Implementation Plan (RIP)” (Phase IV) was submitted to MassDEP on August 10, 2009.

The IRA Completion Report was submitted to MassDEP on November 13, 2009. The IRA Completion Report documented that the IRA was successful in stabilizing Site conditions, eliminating Imminent Hazards, and eliminating and/or mitigating CEPs to the extent feasible, pending the completion of a risk assessment and feasibility study. Therefore, the IRA Completion Report concluded that IRAs were complete, in accordance with the MCP (310 CMR 40.0427). As provided for in the Phase IV, GEI continued to operate and maintain Exposure Pathway Elimination Systems (EPEMs) and implement monitoring and other response actions as CRAs.

1.1.2 Mitigation Options

As explained multiple times in past reports submitted to MassDEP, GEI considered three different options for EPEMs for each property. Options were evaluated in sequential order based on site-specific conditions. The three options were:

- **Option 1 (SSDS)** – A sub-slab depressurization system (SSDS) is appropriate for buildings with a competent concrete floor slab, cast-in-place concrete walls, and good sub-slab air flow. Sub-slab vapors are driven through a piping network through operation of an in-line fan and discharged from an exhaust pipe above the roofline.
- **Option 2 (vapor trench)** – This option is appropriate for buildings with a competent concrete floor, a fieldstone or brick foundation, and poor sub-slab air flow. Pre-design inspection and testing conducted at the Site has demonstrated that the combination of poor sub-slab air flow and a porous foundation prevent an SSDS from operating effectively. To address these conditions, foundation walls are sealed with a

vapor barrier system, a vapor trench is completed around the basement perimeter, and the floor is sealed with epoxy. Sub-slab vapors are vented through a piping network that discharges through an exhaust pipe above the roofline.

- **Option 3 (new slab installation)** – This option is appropriate for buildings with an incompetent concrete floor, fieldstone or brick foundation, and poor sub-slab air flow. Pre-design inspection and testing conducted at the Site has demonstrated that the combination of poor sub-slab air flow, a porous foundation, and incompetent floor slab prevent an SSDS from operating effectively. To address these conditions, foundation walls are sealed with a vapor barrier system. In addition, the floor is removed, vapor sump systems are installed, and a new concrete floor is poured and sealed with a bituthene mastic sealer. Sub-slab vapors are vented through a piping network that discharges through an exhaust pipe above the roofline.

Option 1 – installation of an SSDS was considered first. It was in fact the preferred option. Options 2 and 3 – which MassDEP has termed “passive systems” – were considered only after the Site inspection and engineering evaluation demonstrated that installation of an effective SSDS was not feasible due to building characteristics and other Site-specific factors. Options 2 and 3 can accommodate a fan and be operated as a combined “passive” and “active” system.

MassDEP has acknowledged that Site-specific issues may affect the costs of implementing measures to eliminate or mitigate CEPs. The building and its setting may significantly affect the available remedial options and cost of addressing CEPs. Examples of situations to be considered for this evaluation include: (1) building conditions requiring reconstruction of basement walls or pouring of new slabs; (2) the installation of raised floors to accommodate sub-slab piping systems; or (3) the need for an excessive number of extraction points and fans due to poor sub-slab communication.

GEI conducted pre-design inspections, which in most cases included assessment of geologic conditions beneath the slab, a sub-slab soil communication test, measurement of concentrations of total VOCs beneath the slab using a photoionization detector (PID), and evaluation of the basement floor, foundation walls, and utility penetrations. Based on the results of the communication test, geologic conditions beneath the building slab, and the condition and types of floor, foundations, and utility penetrations, GEI assessed whether installation of an effective SSDS would be feasible. Initial attempts to install SSDSs at the Site demonstrated, for example, that inadequate sub-slab communication, presence of fieldstone or brick basement walls, or incompetent or nonexistent basement flooring would prevent the SSDS from creating a consistent and sufficient pressure gradient. If an SSDS would not be effective, or if a property owner declined an SSDS due to aesthetic concerns

about installation of an external radon-type fan and piping, then other remedial options were evaluated and implemented.

Each EPEM was installed by EMS Development, Inc. (EMS) of Westford, Massachusetts under the supervision of a Massachusetts Licensed Construction Supervisor. To evaluate the effectiveness of each EPEM, confirmatory indoor air sampling was conducted repeatedly at each property. The process for selecting, installing, testing, and in some cases modifying each EPEM was reported in seven IRA status reports and Remedial Monitoring Reports submitted to MassDEP over a period of three years. Despite its active ongoing role at this Site, MassDEP made no written comment on those reports.

1.1.3 NOAF/NON

MassDEP issued an NOAF/NON for the IRA Completion Report on February 1, 2011. Required Action No. 1 of the NON requested that an IRA Plan Modification be submitted within 60 days of the date of the NON and include plans to eliminate or mitigate to the extent feasible CEPs at the following properties:

- 17 Knowlton Street
- 23 Knowlton Street
- 4 Morton Street
- 6-8 Morton Street
- 27 Tufts Street
- 105-107 Washington Street
- 111 Washington Street

Information pertaining to Requirement No. 1 is presented in Section 3 of this Report.

Required Action No. 3 of the NON required documentation demonstrating that all CEPs at the Site be eliminated or mitigated to the extent feasible. This information is presented in Section 4 of this Report. In preparing the NOAF/NON, MassDEP reviewed information only up to the IRA Completion Report submitted on November 13, 2009. GEI has continued to conduct CRAs since that time. In Section 4, GEI evaluated additional properties with characteristics similar to those that were identified in the NOAF/NON based on data collected through February 14, 2011.

With this Report, GEI also is submitting an Updated Revised Supplemental Method 3 Risk Characterization prepared by ARCADIS that addresses the request for additional information in Required Action No. 2 of the NON. The Updated Revised Supplemental Method 3 Risk Characterization also evaluates data collected through February 14, 2011.

This IRA Completion Report Amendment is being submitted in lieu of an IRA Plan Modification since the CEPs at the properties identified in the NOAF/NON have been eliminated or mitigated to the extent feasible (310 CMR 40.0414[3] and [4]) in conformance with the requirements of the MCP, and operation and maintenance of installed EPEMs are being continued as CRAs. The Phase II/Phase III evaluations have been completed for the Site and a Phase IV RIP is being implemented. The IRA has been closed in accordance with the MCP (310 CMR 40.027). CRAs will continue to be performed as Phase IV activities for the Site (310 CMR 40.029), in accordance with the Phase IV RIP.

1.2 Contact Information

Person Undertaking the IRA

John R. Badey
Vice President of Distribution and
Engineering
UniFirst Corporation
68 Jonspin Road
Wilmington, MA 01887
978-658-8888

Licensed Site Professional (LSP)

Ileen S. Gladstone, P.E., LSP, LEED AP
Vice President
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801
781-721-4012
LSP License No. 9719

1.3 Purpose

The purpose of this submittal is to provide additional information for individual properties to respond to the NOAF/NON from the MassDEP dated February 1, 2011, and to document the completion of IRA activities in accordance with the MCP.

1.4 Submittals

This report is being submitted as an attachment to the Response to NOAF/NON, dated April 1, 2011, and addresses Required Actions No. 1 and No. 3 in the NON. The Updated Revised Supplemental Method 3 Risk Characterization requested under Required Action No. 2, prepared separately by ARCADIS, is also being submitted as an attachment to the Response to NOAF/NON. A comprehensive deliverable, containing each of these documents, was submitted with the Post-Audit Completion Statement (BWSC-111) through eDEP (Transaction No. 373046), as requested under Required Action No. 4. A copy of the transmittal form is included in Appendix B.

1.5 Public Involvement (310 CMR 40.1400)

GEI provides key documents to the local public repositories associated with the Site, which are located at the Somerville Central Public Library and the City of Somerville Clerk's

Office. GEI also provides electronic versions of the repository documents to the City for posting to its web site.

GEI sent letters to the Board of Health and Chief Municipal Officer for the City of Somerville informing them of the preparation of this report. Copies of the municipal letters are in Appendix C.

2. IRA Completion Report

The IRA Completion Report addressed in detail each of the requirements of the MCP (310 CMR 40.0427) for closing an IRA. The Report made clear that the substantial work already completed in each prior MCP phase (the CSA, Method 3 Risk Characterizations, Evaluation of Remedial Action Alternatives (RAAs), and Implementation of Selected RAAs) informed and logically dictated its ultimate conclusion that the IRA phase also was complete. The IRA Completion Report stated:

The MCP establishes procedures for addressing CEPs in the interim between their initial identification and completion of a Risk Characterization and feasibility study. The Phase II/Phase III evaluations have been completed for the Site and a Phase IV RIP is being implemented. Installation of additional EPEMs, operation and maintenance of the existing EPEMs and ongoing monitoring will continue as CRAs (Phase IV) as provided in 310 CMR 40.0429(3). This report documents completion of the IRA phase of response actions to address CEPs.

The NOAF/NON focuses on only a small piece of the IRA Completion Report with respect to a few properties. The NOAF/NON treats the IRA Completion Report as if it occurred in a vacuum, and makes no mention of Phases II, III, and IV of the MCP process, which already have been completed at this Site. The NOAF/NON ignores the fundamental premise that the CEP requirements in the MCP ensure that timely action is taken, where feasible, to protect sensitive human receptors from exposures to Site-related contaminants in indoor air or drinking water, *while a disposal site is under investigation*. Likewise, the NOAF/NON ignores the explicit language in 310 CMR 40.0429(c) that CEPs are to be eliminated or mitigated “pending the completion of a risk assessment pursuant to 310 CMR 40.0900 and a feasibility study pursuant to 310 CMR 40.0860.”

Consistent with its overly narrow focus, the NOAF/NON oversimplifies the analysis and conclusions of the IRA Completion Report as to the feasibility of mitigating CEPs in instances where a condition of NSR already has been demonstrated through multiple rounds of sampling and repeated risk characterizations. As MassDEP itself stated at an early stage in the investigations at this Site, the CEP feasibility equation balances the long-term cost of response actions needed to address the CEP with the benefit gained. Once the risks associated with the vapor intrusion pathway are known, and if they are determined to constitute a condition of NSR, then the feasibility equation tips away from continuing mitigation efforts. The NOAF/NON acknowledges neither the place of this IRA Completion

Report in the final stages of the MCP process nor the impact that context has on the feasibility equation.

Given MassDEP's disregard for the regulatory context, specifically within the chronology of investigations at this Site and generally within the MCP process as a whole, it is apparent that further explanation is warranted here.

2.1 Implementation of Preliminary Response Actions and Closing the IRA

The CEP provisions of the MCP are included among requirements for IRAs (40.0414[3] and 40.0427[1][c]). Those provisions call for preliminary response actions to address exposures to potentially sensitive receptors pending more comprehensive evaluation of Site conditions and implementation of CRAs. Generally, IRAs are conducted prior to completing a Phase II and Risk Characterization, when the nature and the extent of a release and its potential risk are still under investigation, and prior to completion of the Phase III and Phase IV.

GEI systematically implemented preliminary response actions to identify and address CEPs, under an approved IRA Plan, pending completion of the Risk Characterization, the Phase III, and the Phase IV. GEI took timely actions to evaluate and address CEPs in residences and at the Capuano Center, and to evaluate and address the vapor intrusion pathway in commercial buildings. As discussed in the Phase II/Phase III and Phase IV RIP, the remedial alternative selected for the Site includes operation of the SSDS and Soil Vapor Extraction (SVE) system at the Property, implementation of EPEMs to address the vapor intrusion pathway and achieve NSR in residences and commercial buildings beyond the Property boundaries, and Monitored Natural Attenuation (MNA).

310 CMR 40.0427(1)(c) states that an IRA shall be considered complete when the IRA condition has been assessed and remediated in a manner and to a degree that will ensure "the elimination, prevention or mitigation of Critical Exposure Pathway(s) without the continued operation and maintenance of active remedial systems, *pending the completion of a risk assessment pursuant to 310 CMR 40.0900 and a feasibility study pursuant to 310 CMR 40.086.*" (Emphasis added.) The emphasized clause cannot simply be ignored – the CEP standard applies "pending" completion of the Site investigation, risk assessment, and feasibility study.

At the time that the IRA Completion Report was filed, this Site was already in Phase IV. The Phase II/Phase III had been completed; the uncertainties about the Site, including the nature and extent of contamination and the risks posed by the Site, had been addressed. At that point, it was entirely appropriate to conclude that the IRA phase had ended, and that further response actions would continue as CRAs.

The MassDEP Q&A [Volume 7, Number 1, January, 2001] states that an “IRA Completion Report can be submitted when all active remedial measures to address CEPs (such as fan-driven ventilation, sub-slab depressurization, and/or point of use water treatment) have been incorporated in a CRA (Phase IV, V, Remedy Operation Status (ROS), Class C RAO).” GEI has completed the Risk Characterization pursuant to 310 CMR 40.9000 and the feasibility study pursuant to 310 CMR 40.0860. The Phase IV RIP incorporates operation and maintenance of the existing EPEMs and installation of EPEMs at residences and commercial buildings where indoor air concentrations do not constitute NSR. Installation of EPEMs in additional residences where indoor air concentrations do not constitute NSR, and when authorized by property owners who have yet to provide access, will be conducted as Phase IV activities in accordance with the provisions of 310 CMR 40.0800, as expressly provided in the MCP (310 CMR 40.0429[3]).

2.2 Feasibility Analysis for CEPs that Constitute NSR

According to 310 CMR 40.0414(3) and (4), response actions are not required to eliminate, mitigate, or prevent a CEP if it can be concluded, based on a preponderance of the evidence, that:

- The CEP does not present an Imminent Hazard, either at present or for the time period that is likely to be required for the implementation and/or completion of CRAs;
- It is not feasible to eliminate or prevent the CEP; and
- In cases where it is not feasible to eliminate or prevent the CEP, it is not feasible to mitigate the CEP.

As part of the IRA, GEI attempted to mitigate CEPs identified in residences at the Site. Significantly, due to the results of ongoing monitoring and MassDEP’s evolving interpretation of what circumstances in fact constituted a CEP, basement spaces identified as CEPs (or not) also evolved over the course of the comprehensive assessment and remedial investigation process.

Once the Risk Characterization and the Phase III Evaluation and Selection of Comprehensive Remedial RAAs were completed, GEI reviewed the status of all residences, including those in which indoor air concentrations constituted NSR. In Section 2.4.1 of the IRA Completion Report, consistent with 310 CMR 40.0414(3) and (4), GEI rebutted the presumption that the CEP must be eliminated or mitigated to the extent feasible for those CEPs which had not yet been mitigated and were at NSR. The Phase III identified technically feasible alternatives for eliminating or mitigating the vapor intrusion pathway. Therefore, the CEP feasibility evaluation considered two additional relevant criteria: access and cost/benefit analysis.

If a homeowner continued to refuse access to mitigate the CEP, whether or not the indoor air concentrations were at a level of NSR, GEI considered it infeasible to eliminate or mitigate the CEP.

If the homeowner did not refuse access, GEI evaluated the cost of the incremental benefit to reduce potential risks beyond the already existing condition of NSR. As provided for in 310 CMR 40.0860(7)(a), “the benefits of implementing a remedial action alternative ... shall justify the related costs *unless the incremental cost* of conducting the remedial action alternative is substantial and disproportionate to the *incremental benefit of risk reduction...*” (Emphasis added.)

As set forth in Section 2.4.1 of the IRA Completion Report, the costs to install and maintain an effective EPEM at this Site are substantial. Building characteristics, geological conditions, and other challenges specific to properties at this Site make them unsuitable for “typical” SSDSs.

In contrast, the incremental benefit of reducing risk below levels that already constitute NSR is minimal. NSR is defined as “a level of control of each identified substance of concern at a site or in the surrounding environment such that no such substance of concern shall present a *significant risk* of harm to health, safety, public welfare, or the environment during any foreseeable period of time.” (M.G.L. c. 21E, § 3A[g].) Once Significant Risk has been defined, mitigating CEPs that do not pose a Significant Risk would be addressing a “risk” that has been quantified and, by definition, determined scientifically not to be significant. Any substantial cost to achieve this additional risk reduction would be considered infeasible in accordance with 310 CMR 40.0860(7)(a). Again, to paraphrase MassDEP, at that point the feasibility equation tips against incurrence of mitigation costs.

310 CMR 40.0860(7)(a) makes it clear that the incremental benefit that may be produced in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost; therefore, it is infeasible to mitigate or eliminate the CEP at the homes where mitigations systems have not been installed and a condition of NSR exists.

In addition, at homes where a passive system has been installed at substantial cost (i.e., \$75,000 to \$125,000), and a condition of NSR has been achieved, it clearly would be infeasible to eliminate the CEP. In those instances, the cumulative costs would swamp any benefit that hypothetically may be achieved through further mitigation.

2.3 Basement Only CEPs

Over the course of the comprehensive assessment and remedy investigation process at this Site, the MassDEP has continuously revisited its interpretation of what constitutes a CEP in

instances where measureable levels of indoor air contaminants are measured in the basement only. At the time the CEP concept was added to the MCP in 1999, MassDEP did not consider a basement presently used for storage or laundry as “occupied living or working space.” MassDEP honored its original intent for nearly a decade. As recently as 2008, during IRA and Phase II assessment activities at this Site, Ms. Irene Dale of MassDEP confirmed that basements presently used for storage or laundry were not considered “occupied living or working space;” therefore, homes where indoor air contaminants were detected only in a minimally used basement were not classified as CEPs.

By January 9, 2009, however, MassDEP apparently had changed its interpretation of “occupied living or working space.” On that date, MassDEP issued a Notice of Audit Finding regarding the Phase II/III stating that “homes with detection of site-related contaminants in basements were not identified as CEPs and must be addressed.”

Based on the February 2011 NOAF/NON, it appears that MassDEP is proposing to make a further change to its interpretation of what constitutes a CEP. It is clear from the MCP and MassDEP’s own pronouncements that a CEP exists only where a building is presently used as “living or working space.” Based on the NOAF/NON, however, MassDEP now appears to be adopting an exception to that rule for basements which, although not presently occupied, may be used as living or working space in the future because they have ceilings that are at least 7 feet in height. This interpretation cannot be squared with the MCP. It is particularly inappropriate here, where Phase II, Phase III, Phase IV, and multiple Method 3 Risk Characterizations already have been completed.

A CEP is a current condition, not a potential future condition. That a basement is amenable to renovation into living or working space in the future does not mean the basement currently is being used as living or working space. The prospective use of the space may be relevant to determining foreseeable future use in a Method 3 Risk Characterization, but it is irrelevant in the context of determining whether a CEP exists. Notwithstanding the fact that a basement not presently used as living or working space is by definition not a CEP, for purposes of this Report and the previous IRA Completion Report, to meet MassDEP’s request, GEI has treated detections of compounds of concern in such basements as if they were CEPs.

2.4 Feasibility Evaluation Presented in the IRA Completion Report

Consistent with 310 CMR 40.0414(3) and (4), GEI rebutted the presumption that the CEP must be eliminated or mitigated to the extent feasible for the residences where property owners denied access, whether or not the concentrations of chlorinated VOCs in indoor air constitute NSR, since it is infeasible to eliminate or mitigate a CEP if the owner of the property will not allow it.

Consistent with 310 CMR 40.0414(3) and (4), and using the cost/benefit criteria in 310 CMR 40.0860(7)(a), GEI also rebutted the presumption that the CEP must be eliminated or mitigated to the extent feasible for the residences where concentrations of chlorinated VOCs in indoor air constituted NSR.

As presented in Section 2.4.1 of the IRA Completion Report, GEI developed cost estimates to mitigate the vapor intrusion pathway for residences at the Site. The cost for the installation, operation, inspection, confirmatory indoor air sampling, consulting services, and regulatory filings associated with an SSDS would be approximately \$90,000. The cost associated with a passive system would be between \$75,000 and \$125,000¹.

For residences where the concentrations in indoor air are at NSR, the cost of a mitigation system is substantial (\$75,000 to \$125,000) as compared to the benefit of additional risk reduction below that which is significant. The incremental benefit, if indeed there is any such benefit, in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost.

GEI conducted the above-described feasibility evaluation in the IRA Completion Report. In this IRA Completion Report Amendment, we have supplemented the analysis previously provided in the IRA Completion Report with a property-specific feasibility evaluation for each of the residences explicitly identified in the NOAF/NON (Section 3), and for residences which were not explicitly identified in NOAF/NON, but would likely be characterized similarly based on data collected since the submittal of the IRA Completion Report (Section 4).

¹ As presented in the IRA Completion Report, the estimated costs for SSDSs and passive EPEMs included annual observation and maintenance costs for 30 years.

3. Properties Identified in the NON

3.1 Introduction

MassDEP raised challenges to the adequacy of measures to address CEPs with respect to seven properties. These properties fall into the following categories:

- Properties without mitigation systems: Access Denied
- Properties without mitigation systems: Basement Only CEPs
- Properties with passive mitigations systems, which MassDEP considered ineffective.

For each of the properties identified in the NOAF/NON, GEI has completed a property-specific feasibility study, as provided for in 310 CMR 40.0413 and 0414, in which it determined the expected costs and comparative benefits of the specific systems necessary, based on building construction and other Site conditions, to eliminate or mitigate CEPs.

3.2 Risk Characterizations

To date four Method 3 Risk Characterizations have been prepared for the Site. The first three were prepared by AMEC Earth & Environmental (AMEC) of Westford Massachusetts and the fourth was prepared by ARCADIS. The first was submitted as part of the Phase II/Phase III Report dated July 14, 2008. The second, a Supplemental Method 3 Risk Characterization, dated May 20, 2009, was submitted to respond to the January 9, 2009 NOAF from MassDEP. In support of the IRA Completion Report, AMEC completed a third Revised Supplemental Method 3 Risk Characterization, dated November 2009, that incorporated data collected at the Site through September 30, 2009. Each of these risk characterizations was based on exposure durations of 20 hours on the first floor and 4 hours in the basement, consistent with MassDEP guidance (WSC Policy #02-430).

Most recently, ARCADIS has prepared an Updated Revised Supplemental Method 3 Risk Characterization responsive to Required Action No. 2 in the February 2011 NON. This risk characterization is based on exposure durations of 12 hours on the first floor and 12 hours in the basement for properties with at least 7 feet of headroom in the basement. For properties with less than 7 feet of headroom in the basement, risk estimates were based on exposure durations of 20 hours on the first floor and 4 hours in the basement. For each residence cited in the NOAF/NON, except for 105-107 Washington Street, exposure to concentrations of PCE detected in indoor air constituted a condition of NSR for building occupants. The indoor air data used in the Risk Characterization for each of these residences are presented on Tables 3-1 through 3-7.

3.3 Mitigation System Assumptions

As presented in the following sections, and consistent with the property evaluation process presented multiple times in past reports submitted to MassDEP, GEI assessed the appropriate mitigation system at each property (Option 1, Option 2, or Option 3) based on circumstances specific to each property, such as geologic conditions beneath the slab, a sub-slab soil communication test, measurement of concentrations of total VOCs beneath the slab using a PID, and evaluation of the basement floor and foundation walls and utility penetrations.

GEI also prepared a cost estimate for sealing potential vapor intrusion routes by applying an epoxy coating throughout a typical residential basement. The total cost of an epoxy modification to the basement – if the floor and walls of the basement are constructed of a material and in a condition that would permit application of an epoxy sealant – is approximately \$35,400. The derivation of this cost estimate is presented in current dollars in Table 3-8 and does not include likely utility modifications, stairway relocations, or furnace relocations. Given the age and construction of homes at this Site, this method of mitigation generally cannot be implemented. Very few of the slabs or basement walls are in a condition to accept epoxy without some preparation. Therefore, installation of a skim coat of new concrete over the existing slab and application of shotcrete to the walls would be required. Most foundation walls are constructed of fieldstone blocks and would need significant preparation in addition to the application of shotcrete to make them amenable to lasting epoxy application. Also, there are building inspection considerations for this type of remedy. For example, building codes require a minimum clearance height once work is performed, and in many instances existing basement floors would have to be lowered before applying a skim coat and performing the epoxy modification. Soil beneath the slab would need to be disposed of at a cost. In addition, without ventilation piping, there is no means of minimizing the concentrations of soil vapor beneath the basement slab.

3.4 Properties without Mitigation System: Access Denied

The NOAF/NON identifies two properties (105-107 Washington Street and 111 Washington Street) where, in MassDEP's opinion, the CEP has not been eliminated or mitigated to the extent feasible because a mitigation system was not offered. MassDEP in fact is mistaken. Mitigation systems were offered but the property owners denied GEI access to install EPEMs at these two properties.

3.4.1 105-107 Washington Street

3.4.1.1 Background

105-107 Washington Street is a multi-family residence located approximately 450 feet southeast of the Property. In May 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in each of these samples. GEI installed an air purifier to mitigate the potential vapor intrusion pathway.

Based on the soil vapor concentrations, GEI recommended an EPEM to the property owners on several occasions; however, the owners have not agreed to the installation.

Since the recommendation to install an EPEM was made without indoor air testing, the property owner permitted GEI to collect indoor air samples in 2009 and 2010. GEI collected indoor air samples from the basement and first floor in February and September 2009, and March 2010 to further evaluate the vapor intrusion pathway. In February 2009, PCE was detected in the basement sample above laboratory detection limits but not in the first floor sample. PCE was detected above laboratory detection limits in the March 2010 samples on both the basement and first floor. PCE was not detected in either sample in September 2009.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR does not exist for the property.

3.4.1.2 Feasibility Evaluation for Eliminating or Mitigating the CEP at 105-107 Washington Street

Consistent with 310 CMR 40.0414(3) and (4), the presumption that the CEP must be eliminated or mitigated to the extent feasible for these residences where access has been denied has been categorically rebutted, whether or not the concentrations of chlorinated VOCs in indoor air constitute NSR, since it is infeasible to eliminate or mitigate a CEP if the property owner will not allow it.

3.4.1.3 105-107 Washington Street Feasibility Evaluation Results

The property owners at 105-107 Washington Street have denied GEI access to install an EPEM. Accordingly, it is infeasible to eliminate or mitigate the CEP at 105-107 Washington Street.

3.4.2 111 Washington Street

3.4.2.1 Background

111 Washington Street is a multi-family residence located approximately 425 feet southeast of the Property. GEI collected one sub-slab soil vapor sample from beneath the building in June 2007. PCE was detected in this sample. GEI installed an air purifier to mitigate the potential vapor intrusion pathway.

GEI recommended an EPEM based on the sub-slab soil vapor results. The owner denied access for installation of the EPEM. Therefore, it is infeasible to eliminate or mitigate the CEP.

Since the recommendation to install an EPEM was made without indoor air testing, the property owner permitted GEI to collect one indoor air sample from the basement in June 2009. PCE was detected above laboratory reporting limits in this sample. GEI also collected samples from the basement in March and November 2010. PCE was not detected above laboratory detection limits in these samples. This property owner will only allow sampling, not EPEM installation, to be conducted in the basement.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.4.2.2 Feasibility Evaluation for Eliminating or Mitigating the CEP at 111 Washington Street

Although installation of an EPEM at 111 Washington Street is infeasible because the owner is denying access, in response to the NOAF/NON, GEI also evaluated the feasibility of installing a mitigation system based on physical conditions and a cost/benefit analysis.

GEI conducted a pre-design inspection and sub-slab soil communication test in the basement on August 9, 2007. The results are presented in Appendix D. A summary of the basement physical conditions observed during the pre-design inspection are in Table 3-9.

The building conditions at 111 Washington Street are not amenable to the installation of a conventional SSDS. The most significant deterrent is that the basement floor is significantly compromised and full sub-slab air flow is not likely to be achieved due to “short-circuiting” through cracks and openings. SSDS installation would require reconstruction of the basement floor, likely consisting of pouring a new slab. Because of the basement floor condition, re-surfacing the floor and applying epoxy is not a viable option.

Considering the above physical conditions and previous experience at other properties, an SSDS would not effectively mitigate the CEP and an Option 3 EPEM would be required. The capital cost of installing an Option 3 EPEM at 111 Washington Street would be approximately \$65,700, including consulting services. In addition to the initial capital cost there are long-term monitoring costs. The total cost of installing and operating an Option 3 EPEM at 111 Washington Street is approximately \$104,000. The derivation of this cost estimate is presented in current dollars in Table 3-10.

3.4.2.3 111 Washington Street Feasibility Evaluation Results

To eliminate or mitigate the CEP at 111 Washington Street, an Option 3 EPEM would be required at an overall cost of approximately \$104,000. The incremental benefit that an Option 3 EPEM may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Accordingly, it is infeasible to eliminate or mitigate the CEP at 111 Washington Street.

3.5 Properties without Mitigation Systems: Basement Only CEP

The NOAF/NON identifies two properties (23 Knowlton Street and 6-8 Morton Street) where, in MassDEP's opinion, the CEP has not been eliminated or mitigated to the extent feasible because a mitigation system was not offered. Initially, feasibility of eliminating or mitigating CEPs was not even an issue at these properties because VOCs were detected only in the basements, and they are not presently used for living space. As described above, MassDEP subsequently changed its interpretation of the term "CEP."

3.5.1 23 Knowlton Street

3.5.1.1 Background

23 Knowlton Street is a multi-family residence located approximately 350 feet east of the Property. In February 2007, GEI collected one sub-slab soil vapor sample from beneath the building. PCE was detected in this sample. GEI collected indoor air samples from the basement and first floor of the building in April and November 2007, February and June 2008, and January and August 2009. PCE was detected above laboratory reporting limits in the basement only in February 2008 and January 2009.

An EPEM was not recommended for 23 Knowlton Street based on the initial detection of PCE in the basement only, and GEI did not classify this as a CEP, consistent with MassDEP policy at that time. GEI continued to monitor this residence, and if measurable levels above the laboratory reporting limits of chlorinated VOCs were detected on the first floor, the

residence would have been reclassified as a CEP and scheduled for mitigation. That did not happen.

The basement ceiling height at 23 Knowlton Street is less than 7 feet (6'9"). The property inspection log documenting the ceiling height is in Appendix E. The basement is used for storage only, and there is no evidence that the basement is used as living or working space. Based on the indoor air sampling results and exposure durations of 20 hours on the first floor and 4 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.5.1.2 Feasibility of Eliminating or Mitigating the CEP at 23 Knowlton Street

As stated above, the basement ceiling height at 23 Knowlton Street is less than 7 feet (6'9"), the basement is used for storage only, and there is no evidence that the basement is used as living or working space. Under MassDEP's most recently announced interpretation of what constitutes a CEP, a CEP does not exist at 23 Knowlton Street, and mitigation is not required. In addition, because exposure to concentrations of PCE detected in indoor air at 23 Knowlton Street constitute a condition of NSR for building occupants, CRAs are not required.

3.5.1.3 23 Knowlton Street Feasibility Evaluation Results

The basement in 23 Knowlton Street has less than 7 feet of headroom. Chlorinated VOCs detected in indoor air in the basement do not constitute a CEP and do constitute a condition of NSR. No further response actions are required.

3.5.2 6-8 Morton Street

3.5.2.1 Background

6-8 Morton Street is a multi-family residence located approximately 150 feet east of the Property. In April 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in each of these samples. GEI collected indoor air samples from the basement and first floor of the building in June and November 2007, February and June 2008, and August 2009. PCE was detected above the laboratory reporting limits in the basement only in June and November 2007, June 2008, and August 2009.

An EPEM was not recommended for 6-8 Morton Street based on the initial detection of PCE in the basement only, and GEI did not classify this as a CEP, consistent with MassDEP policy at that time. GEI continued to monitor this residence, and if measurable levels above the laboratory reporting limits of chlorinated VOCs were detected on the first floor, the residence would have been reclassified as a CEP and scheduled for mitigation. That did not happen.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.5.2.2 Feasibility Evaluation for Eliminating or Mitigating the CEP at 6-8 Morton Street

As part of the response to the NOAF/NON, GEI evaluated the feasibility of installing a mitigation system at 6-8 Morton Street based on physical conditions and the cost/benefit analysis criteria. A pre-design inspection and sub-slab communication test were performed at 6-8 Morton Street on March 8, 2011. The communication test results are presented in Appendix D.

Based on the pre-design inspection results and soil communication test, a typical SSDS would not be effective at 6-8 Morton Street. Portions of the slab are pitted and cracked and the sub-slab communication is poor, which indicates that a large number of extraction points would be necessary to achieve full sub-slab vacuum coverage. Because of the basement floor condition, re-surfacing the floor and applying epoxy is not a viable option. In addition, moderate cracks or open joints are present in the fieldstone foundation walls that would not be addressed with a conventional SSDS. A summary of the basement physical conditions observed during the pre-design inspection are in Table 3-11.

Considering the above physical conditions and previous experience at other properties, an SSDS would not effectively mitigate the CEP and an Option 3 EPEM would be required. The capital cost of installing an Option 3 EPEM would be substantial – approximately \$51,000, including consulting services. In addition to the initial capital cost there are long-term monitoring costs. The total cost of installing an Option 3 EPEM at 6-8 Morton Street is approximately \$89,600. The derivation of this cost estimate is presented in current dollars in Table 3-12.

In addition, based on several visits to the basement at 6-8 Morton Street, it is evident that the basement is only used for storage. Therefore, the potential for exposure to chlorinated VOCs in the basement at 6-8 Morton Street is limited.

3.5.2.3 6-8 Morton Street Feasibility Evaluation Results

To eliminate or mitigate the CEP at 6-8 Morton Street, an Option 3 EPEM would be required at a total cost of approximately \$89,600. The incremental benefit that such a system may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Accordingly, it is infeasible to eliminate or mitigate the CEP at 6-8 Morton Street.

3.6 Properties with Passive Mitigations Systems, Which MassDEP Considered Ineffective

The NOAF/NON identifies three properties where passive systems have been installed and PCE was subsequently detected in one or more post-mitigation sampling rounds (17 Knowlton Street, 4 Morton Street, and 27 Tufts Street). MassDEP asserts that “the option to convert the passive mitigation systems in these homes to active systems” should be considered as a measure to eliminate the CEPs, as if substantial costs had not been incurred already to eliminate or mitigate CEPs at these properties. Notwithstanding that such an approach is fundamentally at odds with the MCP, GEI has given that option due consideration.

3.6.1 17 Knowlton Street

3.6.1.1 Background

17 Knowlton Street is a multi-family residence located approximately 350 feet southeast of the Property. In June 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in each of these samples. GEI collected indoor air samples from the basement and first floor of the building in October 2007. PCE was detected above laboratory reporting limits in the basement and on the first floor. GEI installed an air purifier to mitigate the CEP.

Installation of an Option 3 EPEM was completed in April 2009. GEI collected post-EPEM indoor air samples from the basement and first floor in May 2009. PCE was not detected in the basement in May 2009, but was detected on the first floor at low concentrations (levels that constitute a condition of NSR for building occupants). GEI again collected post-EPEM indoor air samples from the basement and first floor in June 2009 and November 2010. PCE was not detected above laboratory reporting limits in these samples.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.6.1.2 Effectiveness of the EPEM at 17 Knowlton Street and Feasibility Evaluation for Eliminating the CEP

As part of the response to the NOAF/NON, GEI conducted a property-specific cost/benefit analysis for 17 Knowlton Street to determine whether the costs of eliminating the CEP would be substantial and disproportionate to the benefits.

GEI conducted a pre-design inspection and communication test on September 12, 2008 in the basement and the results are presented in Appendix D. Based on the subsurface conditions at the property, an SSDS would not have been effective, and a passive EPEM was installed. The cost of the passive EPEM installation was approximately \$45,300. The passive system could be converted to an active system. The capital cost associated with this conversion would be approximately \$7,000. The total incremental cost of installing and operating an active system at 17 Knowlton Street is approximately \$48,400. The derivation of the conversion cost estimate is presented in current dollars in Table 3-13.

In addition, the three rounds of indoor air sampling collected since the passive EPEM was installed have not detected chlorinated VOCs in the basement. There has been only one, low detection on the first floor.

In addition, based on several visits to the basement at 17 Knowlton Street, it is evident that the basement is used for storage and laundry only. Therefore, the potential for exposure to chlorinated VOCs in the basement at 17 Knowlton Street is limited.

3.6.1.3 17 Knowlton Street Feasibility Evaluation Results

Based on the 17 Knowlton Street feasibility evaluation, the incremental benefit that converting the passive system to an active system may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Furthermore, measures already have been undertaken at a cost of \$45,300 to mitigate the CEP, which costs cannot be ignored as part of the overall feasibility evaluation. Accordingly, it is infeasible to eliminate the CEP at 17 Knowlton Street.

3.6.2 4 Morton Street

3.6.2.1 Background

4 Morton Street is a multi-family residence located approximately 200 feet east of the Property. In June 2007, GEI collected one sub-slab soil vapor sample from beneath the building. PCE was detected in this sample. Based on this soil vapor result, an EPEM was recommended. GEI installed an air purifier to mitigate the potential vapor intrusion pathway.

Installation of an Option 3 EPEM was completed in December 2008. GEI collected post-EPEM indoor air samples from the first floor and basement in March 2009. PCE was not detected on the first floor. PCE was detected in the basement; however, at a concentration that did not constitute NSR.

Based on the post-EPEM indoor air analytical results, the EPEM was modified to extend the wall vapor barrier from grade up to the sill elevation. Post-modification indoor air samples

were collected from the basement and first floor in August 2009. PCE was detected in the basement sample at the laboratory reporting limit. PCE was not detected above laboratory limits on the first floor. GEI collected additional indoor air samples from the basement and first floor in March and December 2010. PCE was detected above laboratory reporting limits in the basement during each of these sampling events, but PCE was not detected on the first floor.

The basement ceiling height at 4 Morton Street is less than 7 feet (6'4"). The property inspection log documenting the ceiling height is in Appendix E. The basement is used for storage and laundry only and there is no evidence that the basement is used as living or working space. Based on the indoor air sampling results and exposure durations of 20 hours on the first floor and 4 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.6.2.2 Feasibility of Eliminating or Mitigating the CEP at 4 Morton Street

As stated above, the basement ceiling height at 4 Morton Street is less than 7 feet (6'4"), the basement is used for storage and laundry only and there is no evidence that the basement is used as living or working space. Since the installation of the EPDM, PCE has only been detected in the basement. Therefore, the CEP has been eliminated. In addition, because exposure to concentrations of PCE detected in indoor air at 4 Morton Street constitute a condition of NSR for building occupants, additional response actions are not required.

3.6.2.3 4 Morton Street Feasibility Evaluation Results

The basement in 4 Morton Street has less than 7 feet of headroom. Indoor air concentrations in the basement do not constitute a CEP and do constitute a condition of NSR. No further response actions are required.

3.6.3 27 Tufts Street

3.6.3.1 Background

27 Tufts Street is a multi-family residence located approximately 40 feet east of the Property. Initially, indoor air samples were collected at 27 Tufts Street on February 2005 (by Shaw Environmental, Inc. (Shaw) of Cambridge, Massachusetts on behalf of MassDEP), then from March through December 2006 by GEI. PCE was detected above laboratory reporting limits in the basement and on the first floor, which is a CEP. GEI installed an air purifier to mitigate the CEP.

Installation of an Option 3 EPDM was completed in September 2008. GEI collected post-EPDM indoor air samples from the basement and first floor of the building in September

2008 and February 2009. PCE was detected in the basement and on the first floor in February 2009.

In light of the sampling results, GEI conducted a performance evaluation of the EPEM. GEI determined that an inaccessible crawl space beneath a portion of the residence may have been functioning as a preferred migration pathway for soil vapor. GEI therefore modified the EPEM by installing an access panel to, and a vapor barrier in, the crawl space.

In February, March, and August 2009, following the EPEM modification, GEI collected additional post-EPEM indoor air samples from the basement and first floor. PCE was not detected above laboratory reporting limits in the first floor and basement samples collected in February and March 2009. PCE was detected above laboratory reporting limits in the basement only in August 2009.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

3.6.3.2 Effectiveness of the EPEM at 27 Tufts Street and Feasibility Evaluation for Eliminating the CEP

As part of the response to the NOAF/NON, we conducted a property-specific cost/benefit analysis for 27 Tufts Street to determine whether the costs of eliminating the CEP would be substantial and disproportionate to the benefits.

Based on the subsurface conditions at the property, a typical SSDS would not have been effective, and a passive EPEM was installed. The cost of the passive EPEM installation was approximately \$57,500. The passive system could be converted to an active system. The capital cost associated with this conversion would be approximately \$7,000. The total incremental cost of installing and operating an active system at 27 Tufts Street would be approximately \$48,400. The derivation of the conversion cost estimate is presented in current dollars in Table 3-14.

3.6.3.3 27 Tufts Street Feasibility Evaluation Results

Based on the 27 Tufts Street feasibility evaluation, the incremental benefit that converting the passive system to an active system may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Furthermore, measures already have been undertaken at a cost of \$57,500 to mitigate the CEP, which costs cannot be ignored as part of the overall feasibility evaluation. Accordingly, it is infeasible to eliminate the CEP at 27 Tufts Street.

4. Properties Not Identified in the NOA

4.1 Introduction

In preparing the NOAF/NON, MassDEP reviewed information collected only up to the period reflected in the IRA Completion Report submitted on November 13, 2009. GEI has continued to conduct CRAs since that time. In the interest of finality, in this section GEI evaluates properties that MassDEP may consider to have characteristics similar to those identified in the NOAF/NON based on data collected since the IRA Completion Report, up to February 14, 2011.

These properties fall into the following categories:

- Properties without mitigation systems: Access Denied
- Properties without mitigation systems: Basement Only CEPs
- Properties without mitigation systems: No Significant Risk
- Properties with incomplete vapor intrusion pathways.
- Properties with passive mitigations systems, which MassDEP may consider ineffective.

For each of these properties, which are similar to those identified in the NOAF/NON, GEI conducted a property-specific feasibility study, as provided for in 310 CMR 40.0413 and 0414, in which it determined the expected costs and comparative benefits of the specific systems necessary, based on building construction and other Site conditions, to eliminate or mitigate CEPs.

4.2 Risk Characterization

The ARCADIS Updated Revised Supplemental Method 3 Risk Characterization, dated April 1, 2011, was based on exposure durations of 12 hours on the first floor and 12 hours in the basement for properties with at least 7 feet of headroom in the basement. For properties with less than 7 feet of headroom in the basement, risk estimates were based on exposure durations of 20 hours on the first floor and 4 hours in the basement. In addition to the residences cited in the NOAF/NON, the Risk Characterization evaluated the remaining residences and commercial properties where indoor air concentrations were measured, including the properties presented in this section. The indoor air data used in the Risk Characterization for each of the residences in Section 4 are presented in Tables 4-1 through 4-16.

4.3 Properties without Mitigation Systems: Access Denied

During the preliminary phase of Site investigations, prior to completion of the Phase II/Phase III and the Revised Supplemental Method 3 Risk Characterization, installation of EPEMs were recommended as IRAs for residences with confirmed CEPs or where sub-slab soil vapor analytical results exceeded risk-based action criteria. Some, but not all, homeowners granted access for installation of EPEMs at that time.

In addition to those listed in Section 3 above, the owners of the following residences denied GEI access to install an EPEM:

- 9 Tufts Street
- 11-13 Tufts Street
- 17 Tufts Street
- 19 Tufts Street
- 25 Tufts Street
- 49 Tufts Street

The Supplemental Method 3 Risk Characterization and the Revised Supplemental Method 3 Risk Characterization which incorporated data collected at the Site through September 30, 2009, confirmed that for each of these residences, the indoor air concentrations constituted a level of NSR. Each of these risk characterizations was based on exposure durations of 20 hours on the first floor and 4 hours in the basement, consistent with MassDEP guidance.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for 11-13, 25, and 49 Tufts Street.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR does not exist for 9, 17, and 19 Tufts Street.

Consistent with 310 CMR 40.0414(3) and (4), the presumption that the CEP must be eliminated or mitigated to the extent feasible for these residences where access has been denied has been categorically rebutted, whether or not the concentrations of chlorinated VOCs in indoor air constitute NSR, since it is infeasible to eliminate or mitigate a CEP if the property owner will not allow it.

4.4 Properties without Mitigation Systems: Basement Only CEPs

GEI has identified three properties, in addition to those listed in Section 3 above, where indoor air concentrations were detected above laboratory reporting limits in the basement only and mitigation systems have not been offered.

- 12-14 Knowlton Street
- 97 Franklin Street
- 99 Franklin Street

12-14 Knowlton Street and 99 Franklin Street were not initially identified for mitigation because indoor air concentrations detected only in the basement originally were not considered CEPs by MassDEP. Chlorinated VOCs were not detected in indoor air at 97 Franklin Street until March 2010, after the IRA Completion Report was submitted.

4.4.1 12-14 Knowlton Street

4.4.1.1 Background

12-14 Knowlton Street is a multi-family residence located approximately 220 feet southeast of the Property. In March 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in each of these samples. GEI collected indoor air samples from the basement and first floor of the building in June and November 2007, August 2008, and January 2009. PCE was detected above laboratory reporting limits in the basement sample collected in November 2007, but not in any other sample.

An EPEM was not recommended for 12-14 Knowlton Street based on the November 2007 detection of PCE in the basement only, and GEI did not classify this as a CEP, consistent with MassDEP policy at that time. GEI continued to monitor this residence, and if measurable levels above the laboratory reporting limits of chlorinated VOCs were detected on the first floor, the residence would have been reclassified as a CEP and scheduled for mitigation. That did not happen.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.4.1.2 Feasibility of Eliminating or Mitigating the CEP at 12-14 Knowlton Street

GEI evaluated the feasibility of installing an EPEM based on observations of physical conditions in the basement made during sampling events and the cost/benefit analysis criteria.

Based on observations of the basement conditions during sampling events, the building conditions at 12-14 Knowlton Street are not amenable to a conventional SSDS. Portions of the slab are thin and heavily cracked and the sub-slab material is primarily silt, which indicates that a large number of extraction points would be necessary to achieve full sub-slab vacuum coverage. Because of the basement floor condition, re-surfacing the floor and applying epoxy is not a viable option. In addition, moderate cracks or open joints are present in the fieldstone foundation walls that would not be addressed with a conventional SSDS.

Considering the above physical conditions and previous experience at other properties, an SSDS would not effectively mitigate the CEP and an Option 3 EPEM would be required. The capital cost of installing an Option 3 EPEM would be substantial. The capital cost of installing an Option 3 EPEM at 12-14 Knowlton Street would be approximately \$82,000. In addition to the initial capital cost there are long-term monitoring costs. The total cost of installing an Option 3 EPEM at 12-14 Knowlton Street is approximately \$121,000. The derivation of this cost estimate is presented in current dollars in Table 4-17.

In addition, based on several visits to the basement at 12-14 Knowlton Street, it is evident that the basement is used only for storage and laundry. Therefore, the potential for exposure to chlorinated VOCs in the basement at 12-14 Knowlton Street is limited.

4.4.1.3 12-14 Knowlton Street Feasibility Evaluation Results

To eliminate or mitigate the CEP at 12-14 Knowlton Street, an Option 3 EPEM would be required at a total cost of approximately \$121,000. The incremental benefit that an EPEM may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Accordingly, it is infeasible to eliminate or mitigate the CEP at 12-14 Knowlton Street.

4.4.2 97 Franklin Street

4.4.2.1 Background

97 Franklin Street is a single family residence located approximately 550 feet east of the Property. In June 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in these samples. GEI collected indoor air samples from the basement and first floor in September 2007, February and July 2008, January 2009, and

March 2010. PCE was not detected above laboratory reporting limits in these samples, except for the sample collected in the basement in March 2010.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.4.2.2 Feasibility of Eliminating or Mitigating the Basement Only Indoor Air Concentrations at 97 Franklin Street

GEI evaluated the feasibility of installing an EPEM at 97 Franklin Street based on observations of physical conditions in the basement during sampling events and the cost/benefit analysis criteria, to determine whether the costs of eliminating or mitigating the indoor air concentrations would be substantial and disproportionate to the benefits.

Based on observations of the basement conditions during sampling events, the building conditions at 97 Franklin Street are not amenable to a conventional SSDS. The sub-slab material was observed to be primarily silt, which indicates a large number of extraction points would be needed to achieve full sub-slab vacuum coverage. In addition, the foundation walls are constructed of fieldstone blocks that include moderate cracks or open joints that would not be addressed with a conventional SSDS.

Considering the above physical conditions and previous experience at other properties, an SSDS would not effectively mitigate the indoor air concentrations and an Option 3 EPEM would be required. The cost associated with installing an Option 3 EPEM would be substantial. The capital cost of installing an Option 3 EPEM at 97 Franklin Street would be approximately \$57,000. In addition to the initial capital cost there are long-term monitoring costs. The total cost of installing Option 3 EPEM at 97 Franklin Street is approximately \$95,500. The derivation of this cost estimate is presented in current dollars in Table 4-18.

In addition, based on several visits to the basement at 97 Franklin Street, it is evident that the basement is used only for storage and laundry. Therefore, the potential for exposure to chlorinated VOCs in the basement at 97 Franklin Street is limited.

4.4.2.3 97 Franklin Street Feasibility Evaluation Results

To eliminate or mitigate the indoor air concentrations at 97 Franklin Street, an Option 3 EPEM would be required at a total cost of approximately \$95,500. The incremental benefit that an EPEM may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Accordingly, it is infeasible to eliminate or mitigate the indoor air concentrations in the basement of 97 Franklin Street.

4.4.3 99 Franklin Street

4.4.3.1 Background

99 Franklin Street is a multi-family residence located approximately 550 feet east of the Property. In May 2007, GEI collected a sub-slab soil vapor sample from beneath the building. PCE was detected in this sample. GEI collected an indoor air sample from the basement in June 2007 and September 2009, and collected an indoor air sample from the basement and first floor in February 2008. PCE was detected above laboratory reporting limits in the June 2007 and February 2008 basement indoor air samples. PCE was not detected above laboratory reporting limits in the February 2008 first floor indoor air sample, nor in the September 2009 basement indoor air sample.

An EPEM was not recommended for 99 Franklin Street based on the June 2007 and February 2008 detection of PCE in the basement only, and GEI did not classify this as a CEP, consistent with MassDEP policy at that time. GEI continued to monitor this residence, and if measurable levels above the laboratory reporting limits of chlorinated VOCs were detected on the first floor, the residence would have been reclassified as a CEP and scheduled for mitigation. That did not happen.

The basement ceiling height at 99 Franklin Street is less than 7 feet (6'5"). The property inspection log documenting the ceiling height is in Appendix E. The basement is used for storage only, and there is no evidence that the basement is used as living or working space. Based on the indoor air sampling results and exposure durations of 20 hours on the first floor and 4 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.4.3.2 Feasibility of Eliminating or Mitigating the CEP at 99 Franklin Street

As stated above, the basement ceiling height at 99 Franklin Street is less than 7 feet (6'5"), the basement is used for storage only, and there is no evidence that the basement is used as living or working space. Under MassDEP's most recently announced interpretation of what constitutes a CEP, a CEP does not exist at 99 Franklin Street, and mitigation is not required. In addition, because exposure to concentrations of PCE detected in indoor air at 99 Franklin Street constitute a condition of NSR for building occupants, response actions are not required.

4.4.3.3 99 Franklin Street Feasibility Evaluation Results

The basement in 99 Franklin Street has less than 7 feet of headroom and the indoor air concentrations do not constitute a CEP and do constitute NSR. No further response actions are required.

4.5 Properties without Mitigation Systems: No Significant Risk

There is one property where, prior to completion of the Phase II/Phase III and the Revised Supplemental Method 3 Risk Characterization, installation of an EPEM was recommended, and the owner denied GEI access to install the EPEM, but allowed additional indoor air testing, the results of which indicate a condition NSR.

4.5.1 162-164 Glen Street

4.5.1.1 Background

162-164 Glen Street is a multi-family residence located approximately 200 feet east of the Property. In June 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in one sample. GEI collected indoor air samples from the basement and first floor in August 2007. PCE was detected in the basement and on the first floor, which is a CEP. GEI installed an air purifier to mitigate the CEP.

Based on the indoor air and soil vapor sampling results, a vapor intrusion pathway was identified at 162-164 Glen Street, and an EPEM was recommended. The owner denied access to GEI to install an EPEM. However, the owner eventually did allow additional indoor air testing, but not until January 2010, after the IRA Completion Report had been submitted to MassDEP.

GEI collected additional indoor air samples from the basement and first floor in January and November 2010, and February 2011. PCE was not detected above laboratory reporting limits in the basement or on the first floor in any of these samples.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.5.1.2 Feasibility of Eliminating or Mitigating the CEP at 162-164 Glen Street

GEI evaluated the feasibility of installing an EPEM based on observations of physical conditions in the basement and the cost/benefit analysis criteria to determine whether the costs of eliminating or mitigating the CEP would be substantial and disproportionate to the benefits. A pre-design inspection and sub-slab soil communication test was performed at 162-164 Glen Street on November 8, 2007. The communication test results are presented in Appendix D.

The results of the pre-design inspection and soil communication test indicate that a conventional SSDS would not be effective at this property. The basement slab is generally

thin and contains some areas of exposed aggregate and small cracks. Because of the basement floor condition, re-surfacing the floor and applying epoxy is not a viable option. Sub-slab communication is poor and the fieldstone walls contain some small cracks and openings that would not be addressed with an SSDS. Based on previous experience, these basement conditions are not amenable to installing an effective SSDS. Therefore, an Option 3 EPEM would be required.

The cost associated with installing an Option 3 EPEM would be substantial. The capital cost of installing an Option 3 EPEM at 162-164 Glen Street would be approximately \$99,600. In addition to the initial capital cost there are long-term monitoring costs. The total cost of installing an Option 3 EPEM at 162-164 Glen Street is approximately \$138,100. The derivation of this cost estimate is presented in current dollars in Table 4-19.

4.5.1.3 162-164 Glen Street Feasibility Evaluation Results

To eliminate or mitigate the CEP at 162-164 Glen Street, an Option 3 EPEM would be required at a cost of approximately \$138,100. Based on the 162-164 Glen Street feasibility evaluation, the incremental benefit that an EPEM may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. In addition, PCE has not been detected in the basement or the first floor during the three indoor air sampling rounds conducted in 2010 and 2011. Accordingly, it is infeasible to eliminate or mitigate the CEP at 162-164 Glen Street.

4.6 Properties with Incomplete Vapor Intrusion Pathways

GEI has identified four properties where measurable concentrations of chlorinated VOCs not attributable to the disposal site have been detected in indoor air:

- 16-20 Alston Street
- 76 Franklin Street
- 45-47 Tufts Street
- 51-51A Tufts Street

4.6.1 16-20 Alston Street

16-20 Alston Street is a multi-family residence located approximately 125 feet west (i.e., upgradient) of the Property, across the Massachusetts Bay Transit Authority (MBTA) railroad tracks. In June 2007, GEI collected one sub-slab soil vapor sample from beneath the building. PCE and 1,1,1-trichloroethane (TCA) were detected above laboratory reporting limits in this sample. In August 2007, GEI collected indoor air samples from the basement and first floor of the building. PCE was detected in the basement but was not detected above

laboratory reporting limits on the first floor. TCA was detected on the first floor, but not in the basement, which was considered a CEP. GEI installed an air purifier to mitigate the CEP.

An EPEM originally was recommended for 16-20 Alston Street, pending additional site investigation; however, after many conversations with the current owners, they refused to have an EPEM installed.

The concentrations of chlorinated VOCs in the shallow groundwater in the vicinity of 16-20 Alston Street (MW114) are less than laboratory reporting limits (1 microgram per liter [$\mu\text{g/L}$]). In addition, the profile of chlorinated VOCs detected in indoor air was not consistent with that measure in indoor air in buildings downgradient of the Property. Based on a lines-of-evidence approach, GEI concluded that there is not a complete vapor intrusion pathway at 16-20 Alston Street and the chlorinated VOCs measured in the indoor air at 16-20 Alston Street are likely not associated with the Site.

4.6.2 76 Franklin Street

76 Franklin Street is a single-family residence located approximately 800 feet east of the Property. In April 2007, GEI collected one sub-slab soil vapor sample from beneath the building. PCE was detected in this sample. GEI collected indoor air samples from the basement and first floor of the building in November 2007 and in February and June 2008. PCE was not detected above laboratory reporting limits in the samples collected from the basement. PCE was detected at the reporting limit of 1.4 micrograms per cubic meter ($\mu\text{g/m}^3$) in the first floor sample collected in November 2007.

An EPEM was originally recommended for 76 Franklin Street, pending additional Site investigation; however, after many conversations with the current owners, they refused to have an EPEM installed.

PCE has only been detected in one of the three rounds of indoor air sampling conducted at 76 Franklin Street at a concentration of $1.4 \mu\text{g/m}^3$, which is the laboratory reporting limit and the MassDEP residential Threshold Value (TV). Where the measured indoor air concentrations are at or below a TV, MassDEP considers further investigation and lines of evidence unnecessary. Moreover, the concentrations of chlorinated VOCs in the shallow groundwater in the vicinity of 76 Franklin Street are less than Method 1 GW-2 standards. Based on a lines-of-evidence approach, GEI has concluded that there is not a complete vapor intrusion pathway at 76 Franklin Street and the chlorinated VOCs measured in the indoor air at 76 Franklin Street are likely not associated with the Site.

4.6.3 45-47 Tufts Street

45-47 Tufts Street is a multi-family residence located approximately 40 feet northeast of the Property. GEI collected indoor air samples from the basement and first floor of Unit 1 (a first floor unit) in July and December 2008, and June 2009, and collected samples from Unit 4 (a first floor unit) in October 2008 and January and June 2009. PCE was not detected above laboratory reporting limits in these samples; however, TCA was detected on the first floor in Unit 1 in June 2009, which would be a CEP if the TCA detection were attributable to the Site. TCA was not detected above laboratory reporting limits in the basement. Sub-slab soil vapor samples were not collected from 45-47 Tufts Street.

TCA has only been detected above the laboratory reporting limit in one of the six rounds of indoor air sampling conducted at 45-47 Tufts Street and only on the first floor. TCA was detected in June 2009 at a concentration of $1.1 \mu\text{g}/\text{m}^3$, which is the laboratory reporting limit. The concentration of TCA detected in June 2009 is below the MassDEP residential TV of $3.0 \mu\text{g}/\text{m}^3$. Moreover, the concentrations of chlorinated VOCs in the shallow groundwater in the vicinity of 45-47 Tufts Street are either less than Method 1 GW-2 standards (MW201), or less than laboratory reporting limits (MW113). Based on a lines-of-evidence approach, GEI has concluded that there is not a complete vapor intrusion pathway at 45-47 Tufts Street and the chlorinated VOCs measured in the indoor air at 45-47 Tufts Street are likely not associated with the Site.

4.6.4 51-51A Tufts Street

51-51A Tufts Street is a multi-family residence located approximately 75 feet northeast of the Property. GEI collected indoor air samples from the basement and first floor unit of the building in July and December 2008, and June 2009. PCE was not detected above laboratory reporting limits in these samples. GEI collected additional indoor air samples from the basement and first floor in March 2010, after the IRA Completion Report was submitted. PCE was detected on the first floor, but was not detected in the basement. Sub-slab soil vapor samples were not collected from 51-51A Tufts Street.

PCE has only been detected above the reporting limit in one of the four rounds of indoor air sampling conducted at 51-51A Tufts Street, and only on the first floor. PCE was detected in March 2010 at a concentration of $1.6 \mu\text{g}/\text{m}^3$, which is only slightly above the laboratory reporting limit ($1.4 \mu\text{g}/\text{m}^3$). The concentration of PCE detected in March 2010 is consistent with the MassDEP residential TV of $1.4 \mu\text{g}/\text{m}^3$, and is less than the 75th percentile MassDEP Typical Indoor Air Concentration (TIAC) of $3.4 \mu\text{g}/\text{m}^3$. Moreover, the concentrations of chlorinated VOCs in the shallow groundwater in the vicinity of 51-51A Tufts Street are either less than Method 1 GW-2 standards (MW201), or less than laboratory reporting limits (MW113). Based on a lines-of-evidence approach, GEI has concluded that there is not a

complete vapor intrusion pathway at 51-51A Tufts Street and the chlorinated VOCs measured in the indoor air at 51-51A Tufts Street are likely not associated with the Site.

4.7 Properties with Passive Mitigations Systems

GEI has identified two properties where, based on MassDEP's comments in the NOAF/NON, MassDEP may question the feasibility of additional measures to eliminate or mitigate the CEP because low levels of PCE have been detected in one or more sampling rounds conducted after installation of passive mitigation systems (Option 3 EPEMs):

- 19-19A Morton Street
- 10 Morton Street

4.7.1 19-19A Morton Street

4.7.1.1 Background

19-19A Morton Street is a multi-family residence located approximately 300 feet east of the Property. In April 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in one sample. GEI collected indoor air samples from the basement and first floor of the building in July 2007, April and August 2008, and January 2009. PCE was detected in the basement and on the first floor in January 2009, which is a CEP. GEI installed an air purifier to mitigate the CEP.

Based on the indoor air results, a vapor intrusion exposure pathway was identified and an EPEM was recommended. Installation of an Option 3 EPEM was completed in August 2009. GEI collected post-EPEM indoor air samples from the first floor and basement in September 2009. PCE was not detected above laboratory reporting limits in these samples.

GEI collected additional indoor air samples from the basement and first floor in January and December 2010, after the IRA Completion Report was submitted. PCE was not detected in the basement or first floor in January 2010. PCE was detected in the basement and on the first floor in December 2010. During the indoor air sampling, the field technician observed a small crack in the epoxy seal at the basement floor-wall interface. The crack was repaired on March 24, 2011. Indoor air samples will be collected to confirm the effectiveness of the repair and indoor air testing results for 19-19A Morton Street will be included in the next Phase IV Status Report.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.7.1.2 Effectiveness of the EPEM at 19-19A Morton Street and Feasibility Evaluation for Eliminating the CEP

GEI conducted a property-specific, cost/benefit analysis for 19-19A Morton Street to determine whether the costs of eliminating the CEP would be substantial and disproportionate to the benefits.

Based on the subsurface conditions at the property, a typical SSDS would not have been effective, and a passive EPEM was installed. The cost of the passive EPEM installation was approximately \$46,500. The passive system could be converted to an active system. The capital cost associated with this conversion would be approximately \$6,700. The total incremental cost of installing and operating an active system at 19-19A Morton Street is approximately \$48,100. The derivation of the conversion cost estimate is presented in current dollars in Table 4-20.

Based on several visits to the basement at 19-19A Morton Street, it is evident that the basement is used for storage only. Therefore, the potential for exposure to chlorinated VOCs in the basement at 19-19A Morton Street is limited.

GEI will evaluate the indoor air sampling results for the samples collected after the minor repair in March 2011 to evaluate the effectiveness of the EPEM modification. The results of that evaluation will be presented in the next Phase IV Status Report.

4.7.1.3 19-19A Morton Street Feasibility Evaluation Results

Based on the 19-19A Morton Street feasibility evaluation, the incremental benefit that converting the passive system to an active system may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Furthermore, measures already have been undertaken at a cost of \$46,500 to mitigate the CEP, which costs cannot be ignored as part of the overall feasibility evaluation. Accordingly, it is infeasible to eliminate the CEP at 19-19A Morton Street.

4.7.2 10 Morton Street

4.7.2.1 Background

10 Morton Street is a single family residence located approximately 150 feet east of the Property. In May 2007, GEI collected two sub-slab soil vapor samples from beneath the building. PCE was detected in one sample. GEI collected indoor air samples from the basement and first floor in August and November 2007, and February 2008. PCE was detected above laboratory reporting limits in the basement in August 2007, and on the first

floor and in the basement in February 2008, which is a CEP. GEI installed an air purifier to mitigate the CEP.

Based on the indoor air sampling results, a vapor intrusion exposure pathway was identified at 10 Morton Street, and an EPEM was recommended. Installation of an Option 3 EPEM was completed in March 2009. GEI collected post-EPEM indoor air samples from the basement and first floor in April 2009. PCE was not detected above laboratory limits in these samples.

GEI collected additional indoor air samples from the basement and first floor in February and November 2010, after the IRA Completion Report was submitted. PCE was not detected in these samples; however, TCE was detected in the basement and on the first floor in November 2010. TCE has not previously been detected in indoor air samples collected from 10 Morton Street. To evaluate the source of TCE detected in indoor air, additional indoor air samples were collected in December 2010. TCE was detected in the basement slightly above reporting limits, but was not detected on the first floor.

Based on the indoor air sampling results and exposure durations of 12 hours on the first floor and 12 hours in the basement, the Updated Revised Supplemental Method 3 Risk Characterization concluded that a condition of NSR exists for the property.

4.7.2.2 Effectiveness of the EPEM at 10 Morton Street and Feasibility Evaluation for Eliminating the CEP

GEI conducted a property-specific, cost/benefit analysis for 10 Morton Street to determine whether the costs of eliminating the CEP would be substantial and disproportionate to the benefits.

Based on the subsurface conditions at the property, an SSDS would not have been effective, and a passive EPEM was installed. The cost of the passive EPEM installation was approximately \$54,600. The passive system could be converted to an active system. The capital cost associated with this conversion would be approximately \$7,000. The total incremental cost of installing and operating an active system at 10 Morton Street is approximately \$48,400. The derivation of the conversion cost estimate is presented in current dollars in Table 4-21.

Based on several visits to the basement at 10 Morton Street, it is evident that the basement is used for storage only. Therefore, the potential for exposure to chlorinated VOCs in the basement at 10 Morton Street is limited.

4.7.2.3 10 Morton Street Feasibility Evaluation Results

Based on the 10 Morton Street feasibility evaluation, the incremental benefit that converting the passive system to an active system may produce in reducing potential risks beyond the already existing condition of NSR does not justify the substantial cost. Furthermore, measures already have been undertaken at a cost of \$54,600 to mitigate the CEP, which costs cannot be ignored as part of the overall feasibility evaluation. Accordingly, it is infeasible to eliminate the CEP at 10 Morton Street.

5. IRA Completion Statement

The MCP establishes procedures for addressing CEPs in the interim between their initial identification and completion of a risk assessment and feasibility study. The Phase II/Phase III evaluations have been completed for the Site and a Phase IV RIP is being implemented. Installation of additional EPEMs, operation and maintenance of the existing EPEMs, and ongoing monitoring will continue as CRAs (Phase IV) as provided for in 310 CMR 40.0429(3). Partial RAOs are being prepared for those properties which have achieved NSR.

This IRA Completion Report Amendment documents that the activities performed up until the IRA Completion Report was submitted on November 13, 2009 were appropriate and sufficient to close the IRA. In addition, based on additional data collected, evaluations conducted, and CRAs performed after the IRA Completion Report was submitted, this Report reaffirms the completion of the IRA.

Tables

Table 1-1

Summary of MassDEP IRA Regulatory Submittals and Other CRAs

IRA Completion Report Amendment

50 Tufts Street

Somerville, Massachusetts

18. **Remedial Monitoring Report No. 1**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 30, 2007.
19. **Monthly Remedial Monitoring Report No. 2**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 30 2007.
20. **Monthly Remedial Monitoring Report No. 3**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 30, 2007.
21. **Monthly Remedial Monitoring Report No. 4**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 30, 2007.
22. **IRA Plan Modification No. 7**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated October 11, 2007.
23. **IRA Plan Modification No. 8**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated October 11, 2007.
24. **Monthly Remedial Monitoring Report No. 5**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated October 19, 2007.
25. **Monthly Remedial Monitoring Report No. 6A**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated October 31, 2007.
26. **Monthly Remedial Monitoring Report No. 6B**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 8, 2007.
27. **Monthly Remedial Monitoring Report No. 7A**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 8, 2007.
28. **Monthly Remedial Monitoring Report No. 7B**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 8, 2007.
29. **IRA Plan Modification No. 9**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 9, 2007.
30. **IRA Status Report No. 4**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 9, 2007.
31. **IRA Plan Modification No. 10**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated December 17, 2007.
32. **Phase II Scope of Work Amendment No. 2**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated February 19, 2008.
33. **IRA Plan Modification No. 11**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated April 9, 2008.

Table 1-1

Summary of MassDEP IRA Regulatory Submittals and Other CRAs

IRA Completion Report Amendment

50 Tufts Street

Somerville, Massachusetts

34. **IRA Plan Modification No. 12**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated April 15, 2008.
35. **IRA Status Report No. 5 & Remedial Monitoring Report No. 8**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated May 15, 2008.
36. **IRA Plan Modification No. 13**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated May 16, 2008.
37. **Phase II Comprehensive Site Assessment, Method 3 Risk Characterization, and Phase III Remedial Action Plan**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated July 14, 2008.
38. **IRA Plan Modification No. 14**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 21, 2008.
39. **IRA Status Report No. 6 & Remedial Monitoring Report No. 9**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 10, 2008.
40. **IRA Status Report No. 7 & Remedial Monitoring Report No. 10**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated May 11, 2009.
41. **Response to Notice of Audit Findings**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated May 20, 2009.
42. **Phase IV Remedy Implementation Plan**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 10, 2009.
43. **Request for Change of Status of Hazardous Waste Activity**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated September 21, 2009.
44. **Immediate Response Action Completion Report and Remedial Monitoring Report No. 11**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 13, 2009.
45. **Notice of Activity and Use Limitation (12 Morton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 19, 2009.
46. **Notice of Activity and Use Limitation (95R Franklin Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated November 19, 2009.
47. **Notice of Activity and Use Limitation (10 Morton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated January 15, 2010.
48. **Notice of Activity and Use Limitation (19-19A Morton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated January 21, 2010.
49. **Phase IV Status Report No. 1 and Remedial Monitoring Report No. 12**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated February 8, 2009.

Table 1-1

**Summary of MassDEP IRA Regulatory Submittals and Other CRAs
IRA Completion Report Amendment
50 Tufts Street
Somerville, Massachusetts**

50. **Notice of Activity and Use Limitation (17 Knowlton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated March 5, 2010.
51. **Notice of Activity and Use Limitation (11 Morton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated April 16, 2010.
52. **Notice of Activity and Use Limitation (32 Knowlton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated April 26, 2010.
53. **Class A-3 Response Action Outcome Partial Statement for 95R Franklin Street, Somerville, Massachusetts**, RTN 3-23246, 50 Tufts Street Site, Somerville, Massachusetts, dated April 30, 2010.
54. **Phase IV Status Report No. 2 and Remedial Monitoring Report No. 13**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated August 4, 2010.
55. **Class B-1 Response Action Outcome Partial Statement for 10 Franklin Avenue, Somerville, Massachusetts**, RTN 3-23246, 50 Tufts Street Site, Somerville, Massachusetts, dated August 10, 2010.
56. **Notice of Activity and Use Limitation (9 Knowlton Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated October 14, 2010.
57. **Class B-1 Response Action Outcome Partial Statement for 12 Franklin Avenue, Somerville, Massachusetts**, RTN 3-23246, 50 Tufts Street Site, Somerville, Massachusetts, dated November 5, 2010.
58. **Class B-1 Response Action Outcome Partial Statement for 18 Franklin Avenue, Somerville, Massachusetts**, RTN 3-23246, 50 Tufts Street Site, Somerville, Massachusetts, dated November 5, 2010.
59. **Notice of Activity and Use Limitation (166-168 Glen Street)**, RTN 3-23246, 50 Tufts Street, Somerville, Massachusetts, dated February 11, 2011.
60. **Phase IV Status Report No. 3 and Remedial Monitoring Report No. 14**, RTN 3-23246, 50 Tufts Street Site, Somerville, Massachusetts, dated February 10, 2011.

Table 3-1
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
105-107 Washington Street
Somerville, Massachusetts

Sample Location:		105-107 Washington Street									
		105-107WASH-1		105-107WASH-B		105WASH-1		105WASH-B		105WASH-1	
		2/20/09		2/20/09		9/16/09		9/16/09		3/19/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method										
Volatile Organic Compounds (VOCs)	TO-15										
Tetrachloroethylene (PCE)		0.62 J	0.092 J	1.7	0.25	< 1.4	< 0.20	< 1.4	< 0.20	2.5	0.37
										12	1.7

- General Notes:**
1. IRA = Immediate Response Action.
 2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
 2. µg/m³ = micrograms per cubic meter.
 3. ppbv = parts per billion by volume.
 4. "≤" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:
 J The reported result is below the laboratory reporting limit and is estimated.

Table 3-2
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
111 Washington Street
Somerville, Massachusetts

Analyte		Sample Location: Sample Name: Sample Date: Units:		111 Washington Street			
				111 WASH-B 6/30/09	111 WASH-B 3/3/10	111 WASH-B 11/22/10	
				µg/m ³	µg/m ³	µg/m ³	ppbv
				ppbv	ppbv	ppbv	ppbv
Volatile Organic Compounds (VOCs)		Method					
Tetrachloroethylene (PCE)		TO-15		1.7	< 1.4	< 1.4	< 0.20
				0.25	< 0.20		

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.

Table 3-3
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
23 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		23 Knowlton Street					
		23 KNOW-1 4/23/07		23 KNOW-B 4/23/07		23KNOW-1 11/7/07	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		1.0 J	0.16 J	< 1.3	< 0.20	0.69 J	0.11 J
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	0.38 J	0.093 J
Tetrachloroethylene (PCE)		1.3 J	0.19 J	1.2 J	0.18 J	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	0.87 J	0.16 J	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 3-3
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
23 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		23 Knowlton Street (continued)							
		23KNOW-1 2/5/08		23KNOW-B 2/5/08		23KNOW-1 6/20/08		23KNOW-B 6/20/08	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Dichloroethane, 1,2- Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	1.3	0.20	0.69 J	0.11 J
		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		< 1.4	< 0.20	8.8	1.3	< 1.4	< 0.20	< 1.4	< 0.20
		< 1.1	< 0.20	0.35 J	0.064 J	0.55 J	0.10 J	1.4	0.25
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Chemical Testing Results - Indoor Air

23 Knowlton Street

Sample Location: Sample Name: Sample Date: Units:		23 Knowlton Street (continued)							
		23KNOW-1 1/15/09		23KNOW-B 1/15/09		23KNOW-1 8/10/09		23KNOW-B 8/10/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		Method							
Volatile Organic Compounds (VOCs) Carbon tetrachloride Dichloroethane, 1,2- Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	TO-15	0.82 J	0.13 J	0.63 J	0.10 J	< 1.3	< 0.20	< 1.3	< 0.20
		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	0.82	0.21
		1.3 J	0.19 J	4.5	0.66	< 1.4	< 0.20	< 1.4	< 0.20
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.2	0.22
		< 1.1	< 0.20	< 1.1	< 0.20	1.2	0.23	< 1.1	< 0.20

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

J The reported result is below the laboratory reporting limit and is estimated.

Table 3-4

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
6-8 Morton Street
Somerville, Massachusetts

6-8 Morton Street									
Sample Location:		6MORT-1		6MORT-B		6-8MORT-1		6-8MORT-B	
Sample Name:		6/18/07		6/18/07		11/7/07		11/7/07	
Sample Date:		6/18/07		6/18/07		11/7/07		11/7/07	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
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Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³	
Units:		ppbv		ppbv		ppbv		ppbv	
Units:									

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Chemical Testing Results - Indoor Air IRA Completion Report Amendment

General Notes:

- ### Qualifying Note:

GEI Consultants, Inc.

Table 3-4

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
6-8 Morton Street
Somerville, Massachusetts

Sample Location:			6-8 Morton Street (continued)			
Sample Name:			6-8 MORT-1		6-8 MORT-B	
Sample Date:			8/4/09		8/4/09	
Units:						
Analyte		Method	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride		TO-15	< 1.3	< 0.20	< 1.3	< 0.20
Tetrachloroethylene (PCE)			< 1.4	< 0.20	3.3	0.49

General Notes:

- IRA = Immediate Response Action.
- Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
- µg/m³ = micrograms per cubic meter.
- ppbv = parts per billion by volume.
- "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 3-5

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
17 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		17 Knowlton Street pre-EPEM			
		17KNOW-1 10/5/07		17KNOW-B 10/5/07	
		$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Analyte		Method			
Volatile Organic Compounds (VOCs)		TO-15			
Carbon tetrachloride					
1,2-Dichloroethane (DCA)					
Tetrachloroethylene (PCE)					
		0.63 J 0.71 J 1.7	0.10 J 0.13 J 0.25	0.60 J < 1.1 2.7	0.095 J < 0.20 0.40

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
4. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. The sample collected in November 2010 was collected over a 24-hour period from November 18 to November 19, 2010.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 3-5
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
17 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		17 Knowlton Street post-EPEM									
		17KNOW-1 5/13/09		17KNOW-B 5/13/09		17KNOW-1 6/5/09		17KNOW-B 6/5/09		17KNOW-B 11/19/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		Method									
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane (DCA) Tetrachloroethylene (PCE)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		0.81	0.20	< 0.81	< 0.20	0.93	0.23	< 0.81	< 0.20	< 0.81	< 0.20
		1.6	0.23	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20

- General Notes:**
- IRA = Immediate Response Action.
 - EPEM = Exposure Pathway Elimination Measure.
 - Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
 - µg/m³ = micrograms per cubic meter.
 - ppbv = parts per billion by volume.
 - "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
 - The sample collected in November 2010 was collected over a 24-hour period from November 18 to November 19, 2010.

Qualifying Note:
 J The reported result is below the laboratory reporting limit and is estimated.

Table 3-6
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
4 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		4 Morton Street post-EPEM					
		4MORT-1 8/10/09		4MORT-B 8/10/09		4MORT-1 3/4/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane (DCA)		0.65 J	0.16 J	< 0.79	< 0.20	2.2	0.55
Tetrachloroethylene (PCE)		< 1.4	< 0.20	1.4	0.20	< 1.4	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
4. µg/m³ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "J" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. **No pre-EPEM indoor air samples were collected. The EPEM was installed based on sub-slab soil vapor testing results.**
8. Samples collected in March 2010 were collected over a 24-hour period from March 3 to 4, 2010
9. Samples collected in December 2010 were collected over a 24-hour period from December 4 to 5, 2010

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 3-6
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
4 Morton Street
Somerville, Massachusetts

Analyte		Sample Location: Sample Name: Sample Date: Units: Method		4 Morton Street post-EPEM (continued)				
				4MORT-B 3/4/10	4MORT-1 12/5/10	4MORT-B 12/5/10	4MORT-B	
				µg/m ³	µg/m ³	ppbv	µg/m ³	µg/m ³
Volatile Organic Compounds (VOCs)		TO-15						
Carbon tetrachloride				< 1.3	< 1.3	<0.20	< 1.3	< 0.20
1,2-Dichloroethane (DCA)				< 0.81	NT	NT	NT	NT
Tetrachloroethylene (PCE)				5.7	< 1.4	< 0.20	15	2.2

- General Notes:**
1. IRA = Immediate Response Action.
 2. EPEM = Exposure Pathway Elimination Measure.
 3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
 4. µg/m³ = micrograms per cubic meter.
 5. ppbv = parts per billion by volume.
 6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
 7. **No pre-EPEM indoor air samples were collected. The EPEM was installed based on sub-slab soil vapor testing results.**
 8. Samples collected in March 2010 were collected over a 24-hour period from March 3 to 4, 2010
 9. Samples collected in December 2010 were collected over a 24-hour period from December 4 to 5, 2010

Qualifying Note:
J The reported result is below the laboratory reporting limit and is estimated.

Table 3-7
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
27 Tufts Street
Somerville, Massachusetts

Analyte		Post-EPEM 27 Tufts Street									
		Sample Location:		27 TUFT-1		27 TUFT-B		27TUFT-1		27 TUFT-B	
		Sample Name:		2/25/09		2/25/09		3/4/09		3/4/09	
		Sample Date:		GEI		GEI		GEI		GEI	
		Collected By:									
		Units:									
		Method									
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride											
Chloroethane											
Chloromethane											
Methylene chloride											
Tetrachloroethylene (PCE)											
1,1,1-Trichloroethane (TCA)											
Trichloroethylene (TCE)											

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see attached laboratory data sheets.
4. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. NT = Not tested.
8. Samples ending with -1 and -1(2), -B and -B(2), -1A and -1B, and -B1 and -B2 are field duplicates of each other.
10. Samples from 2005 collected by Shaw Environmental, Inc.
11. * = Improper duplicate precision, this sampling was repeated on September 26, 2008.
9. The samples collected in August 2009 were collected over a 24-hour period from August 24 to 25, 2009.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 3-8
Epoxy Seal Entire Basement Walls and Floor
IRA Completion Report Amendment
Various -- Tufts Street
Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Basement Epoxy Seal -- Installation					
	<i>Engineering Design</i>				
	Basement inspections, materials planning, etc.	Lump Sum	\$3,880	1	\$3,880
	Meetings, coordination, documentation	Lump Sum	\$3,880	1	\$3,880
	<i>Installation</i>				
	Basement cleanup	day	\$1,500	2	\$3,000
	Clean/prepare walls for shotcrete	day	\$1,500	2	\$3,000
	Shotcrete walls	day	\$2,500	2	\$5,000
	Pour new thin slab over existing slab	Lump Sum	\$5,000	1	\$5,000
	Apply epoxy to walls/floor	day	\$1,500	2	\$3,000
	Cost of epoxy and application supplies	Lump Sum	\$2,000	1	\$2,000
	Storage for belongings	month	\$150	1	\$150
	Construction foreman oversight	day	\$500	5	\$2,500
	Return belongings	day	\$1,500	2	\$3,000
	Miscellaneous (tools, trucks, mobilization, supplies, etc.)	Lump Sum	\$1,000	1	\$1,000
				Sub-Total:	\$35,410
Basement Epoxy Seal -- Operation, Maintenance, and Monitoring					
	<i>Operation</i>				
	Annual electrical costs	Year	\$0	30	\$0
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation	Year	\$0	30	\$0
				Sub-Total:	\$0
				Total:	\$35,410

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. The above costs represent a conservative estimate and do not account for complicating factors such as utility re-routing, furnace removal/replacement, water issues, sump sealing, etc.

Table 3-9

Summary of Basement Physical Conditions

IRA Completion Report Amendment

111 Washington Street

Somerville, Massachusetts

Slab Condition:	Fair/Poor
Sub-slab material:	Silt
Average vacuum radius of influence:	5 ft
Slab area (sq. ft):	730
Estimated number of extraction points:	6
Expected Fan Model	GP501
Conventional SSDS?	No

General Notes:

1. IRA = Immediate Response Action.
2. ft = foot/feet.
3. sq. ft = square feet.
4. SSDS = Sub-Slab Depressurization System.
5. Vacuum radius of influence is defined as a minimum of 0.010 inches water column measured in the sub-slab when 4 inches of water column is applied at a single test extraction point. Test is repeated in two different locations.
6. See residential Pre-Design Inspection Form for more details.

Table 3-10
Option 3 EPEM Installation and Operational Costs
IRA Completion Report Amendment
111 Washington Street
Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Option 3 EPEM -- Installation	<i>Engineering Design</i>				
	Vapor pit/piping layout, drawings, testing	Lump Sum	\$2,040	1	\$2,040
	Meetings, coordination, documentation	Lump Sum	\$1,960	1	\$1,960
	<i>Coordination and Oversight</i>				
	GEI labor	Lump Sum	\$2,960	1	\$2,960
	<i>Installation</i>				
	Mobilization and basement preparation	Lump Sum	\$1,900	1	\$1,900
	Demolition and excavation	Lump Sum	\$4,400	1	\$4,400
	EPEM component installation	Lump Sum	\$16,000	1	\$16,000
	Plumbing and heating	Lump Sum	\$1,300	1	\$1,300
	Carpentry	Lump Sum	\$5,300	1	\$5,300
	Furnace replacement	Lump Sum	\$5,000	2	\$10,000
	Hot water heater replacement	Lump Sum	\$2,000	0	\$0
	Crawl space	Lump Sum	\$10,000	1	\$10,000
	Contractor overhead/foreman oversight	Lump Sum	\$9,800	1	\$9,800
				Sub-Total:	\$65,660
Option 3 EPEM -- Reporting, Operation, Maintenance, and Monitoring	<i>Closure Documentation</i>				
	GEI labor	Lump Sum	\$3,750	1	\$3,750
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation	Year	\$1,160	30	\$34,800
				Sub-Total:	\$38,550
				Total:	\$104,210

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Does not include air sampling time or materials costs.

Table 3-11
Summary of Basement Physical Conditions
IRA Completion Report Amendment
6-8 Morton Street
Somerville, Massachusetts

Slab Condition:	Fair/Poor
Sub-slab material:	Silt
Average vacuum radius of influence:	15 ft
Slab area (sq. ft):	960
Estimated number of extraction points:	4
Expected Fan Model	HS5000
Conventional SSDS?	No

General Notes:

1. IRA = Immediate Response Action.
2. ft = feet.
3. sq. ft = square feet
4. SSDS = Sub-Slab Depressurization System.
5. Vacuum radius of influence is defined as a minimum of 0.010 inches water column measured in the sub-slab when 4 inches of water column is applied at a single test extraction point. Test is repeated in two different locations.
6. Water was observed at bottom of slab during pre-design inspection. May require vapor sumps rather than standard suction pits.
7. See residential Pre-Design Inspection Form for more details.

Table 3-12

Option 3 EPEM Installation and Operational Costs
IRA Completion Report Amendment
 6-8 Morton Street
 Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Option 3 EPEM -- Installation					
<i>Engineering Design</i>					
	Vapor pit/piping layout, drawings, testing	Lump Sum	\$2,040	1	\$2,040
	Meetings, coordination, documentation	Lump Sum	\$1,960	1	\$1,960
<i>Coordination and Oversight</i>					
	GEI labor	Lump Sum	\$2,960	1	\$2,960
<i>Installation</i>					
	Mobilization and basement preparation	Lump Sum	\$1,900	1	\$1,900
	Demolition and excavation	Lump Sum	\$4,800	1	\$4,800
	EPEM component installation	Lump Sum	\$17,400	1	\$17,400
	Plumbing and heating	Lump Sum	\$1,300	1	\$1,300
	Carpentry	Lump Sum	\$5,300	1	\$5,300
	Furnace replacement	Lump Sum	\$5,000	0	\$0
	Hot water heater replacement	Lump Sum	\$2,000	3	\$6,000
	Crawl space	Lump Sum	\$10,000	0	\$0
	Contractor overhead/foreman oversight	Lump Sum	\$7,400	1	\$7,400
				Sub-Total:	\$51,060
Option 3 EPEM -- Reporting, Operation, Maintenance, and Monitoring					
<i>Closure Documentation</i>					
	GEI labor	Lump Sum	\$3,750	1	\$3,750
<i>Maintenance and Monitoring</i>					
	GEI check system, documentation	Year	\$1,160	30	\$34,800
				Sub-Total:	\$38,550
				Total:	\$89,610

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Does not include air sampling time or materials costs.

Table 3-13

Modify Existing Passive EPEM to Active SSDS

IRA Completion Report Amendment

17 Knowlton Street

Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost		
Upgrade to Active SSDS -- Installation	<i>Engineering Design</i> Data review, fan selection, testing Meetings, coordination, documentation <i>Installation</i> RadonAway GP501 fan Install electrical panel, meter, service Installation Labor Foreman oversight Miscellaneous (tools, trucks, mobilization, etc.)	Lump Sum	\$1,440	1	\$1,440		
		Lump Sum	\$3,080	1	\$3,080		
		each	\$239	1	\$239		
		each	\$1,000	1	\$1,000		
		hour	\$50	8	\$400		
		hour	\$80	4	\$320		
		Lump Sum	\$500	1	\$500		
				Sub-Total:		\$6,979	
		Option 1 (SSDS) -- Operation, Maintenance, and Monitoring	<i>Operation</i> Annual electrical costs <i>Maintenance and Monitoring</i> GEI check system, documentation, reporting	Year	\$219	30	\$6,570
				Year	\$1,160	30	\$34,800
				Sub-Total:		\$41,370	
Total:				\$48,349			

General Notes:

1. EPEM = Exposure Pathway Elimination Measure.
2. SSDS = Sub-Slab Depressurization System.
3. IRA = Immediate Response Action.
4. The above costs assume that no modifications will be made to the existing piping layout or other EPEM components.
5. Does not include air sampling time + materials or reporting costs.

Table 3-14

Modify Existing Passive EPEM to Active SSDS

IRA Completion Report Amendment

27 Tufts Street

Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Upgrade to Active SSDS -- Installation	<i>Engineering Design</i>				
	Data review, fan selection, testing	Lump Sum	\$1,440	1	\$1,440
	Meetings, coordination, documentation	Lump Sum	\$3,080	1	\$3,080
	<i>Installation</i>				
	RadonAway GP501 fan	each	\$239	1	\$239
	Install electrical panel, meter, service	each	\$1,000	1	\$1,000
	Installation Labor	hour	\$50	8	\$400
	Foreman oversight	hour	\$80	4	\$320
	Miscellaneous (tools, trucks, mobilization, etc.)	Lump Sum	\$500	1	\$500
				Sub-Total:	\$6,979
Option 1 (SSDS) -- Operation, Maintenance, and Monitoring	<i>Operation</i>				
	Annual electrical costs	Year	\$219	30	\$6,570
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation, reporting	Year	\$1,160	30	\$34,800
				Sub-Total:	\$41,370
				Total:	\$48,349

General Notes:

1. EPEM = Exposure Pathway Elimination Measure.
2. SSDS = Sub-Slab Depressurization System.
3. IRA = Immediate Response Action.
4. The above costs assume that no modifications will be made to the existing piping layout or other EPEM components.
5. Does not include air sampling time + materials or reporting costs.

Table 4-1

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
9 Tufts Street
Somerville, Massachusetts

Analyte		Location Name:		9 Tufts Street							
		Sample Name:		IA-6 (B)		9TUFTS-1L		9TUFTS-1R		9TUFTS-BR	
		Sample Date:		2/23/05		3/23/06		3/23/06		3/23/06	
		Collected By:		Shaw		GEI		GEI		GEI	
		Units:									
		Method									
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride											
Chloroform											
Chloromethane											
Methylene chloride											
Tetrachloroethylene (PCE)											
1,1,1-Trichloroethane (TCA)											
Trichloroethylene (TCE)											

General Notes:

- IRA = Immediate Response Action.
Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
- $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
- ppbv = parts per billion by volume.
- "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
- NT = Not Tested.
- 1L = First floor, left side of house.
- 1R = First floor, right side of house.
- Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- B The reported result is attributed to sampling or laboratory contamination.
- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-1
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
9 Tufts Street
Somerville, Massachusetts

Analyte		Method		9 Tufts Street (continued)											
				Location Name:		9TUFTS-1L		9TUFTS-1R		9TUFTS-BR		9TUFTS-1L			
				Sample Name:		7/24/06		7/24/06		7/24/06		10/2/06			
Sample Date:		Collected By:		GEI		GEI		GEI		GEI		GEI			
Units:				μg/m ³		ppbv		μg/m ³		ppbv		μg/m ³		ppbv	
TO-15															
Volatile Organic Compounds (VOCs)															
Carbon tetrachloride				< 1.3		< 0.20		< 1.3		< 0.20		< 1.3		< 0.20	
Chloroform				0.88 J		0.18 J		2.3		0.47		1.2		NT	
Chloromethane				1.0		0.49		1.1		0.55		0.95		NT	
Methylene chloride				4.2 B		1.2 B		6.6 B		1.9 B		11 B		NT	
Tetrachloroethylene (PCE)				1.2 J		0.18 J		2.0		0.29		3.1		0.52	
1,1,1-Trichloroethane (TCA)				< 0.79		< 0.20		< 0.79		< 0.20		< 0.79		< 0.20	
Trichloroethylene (TCE)				< 1.1		< 0.20		< 1.1		< 0.20		< 1.1		< 0.20	

Table 4-1

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
9 Tufts Street
Somerville, Massachusetts

9 Tufts Street (continued)											
Location Name:		9TUFTS-1R 10/2/06 GEI		9TUFTS-BR 10/2/06 GEI		9 TUFTS-1L 12/15/06 GEI		9 TUFTS-1R 12/15/06 GEI		9 TUFTS-BR 12/15/06 GEI	
Sample Name:		µg/m ³		ppbv		µg/m ³		ppbv		µg/m ³	
Sample Date:											
Collected By:											
Units:											
Method											
TO-15											
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride		< 1.3		< 0.20		0.62 J		0.099 J		0.59 J	
Chloroform		NT		NT		NT		NT		NT	
Chloromethane		NT		NT		NT		NT		NT	
Methylene chloride		NT		NT		NT		NT		NT	
Tetrachloroethylene (PCE)		6.2		0.91		1.9		0.28		0.64 J	
1,1,1-Trichloroethane (TCA)		< 0.79		< 0.20		< 0.79		< 0.20		< 0.79	
Trichloroethylene (TCE)		< 1.1		< 0.20		< 1.1		< 0.20		< 1.1	
		</									

General Notes:

1. IRA = Immediate Response Action.
Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
- "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. 1L = First floor, left side of house.
8. 1R = First floor, right side of house.
9. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- B The reported result is attributed to sampling or laboratory contamination.
- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

**Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
11-13 Tufts Street
Somerville, Massachusetts**

General Notes:

- ### Qualifying Notes:

- GEI Consultants, Inc.

Table 4-2
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
11-13 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By: Units:		11-13 Tufts Street (continued)							
		11/13TUFTS-1 3/24/06 GEI		11/13TUFTS-B 3/24/06 GEI		11/13 TUFTS-1 6/29/06 GEI		11/13 TUFTS-B 6/29/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	0.69 J	0.11 J	0.69 J	0.11 J
		< 0.98	< 0.20	< 0.98	< 0.20	1.5	0.30	< 0.98	< 0.20
		1.4 G	0.70 G	1.4 G	0.68 G	2.7	1.3	1.7	0.80
		1.2 J+	0.34 J+	4.5 J+	1.3 J+	2.7 J+	0.77 J+	5.2 J+	1.5 J+
		<1.4	<0.20	<1.4	<0.20	0.8	0.23	<1.4	<0.20
		< 1.4	< 0.20	< 1.4	< 0.20	1.8	0.27	2.4	0.36
		< 1.1	< 0.20	< 1.1	< 0.20	0.71 J	0.13 J	< 1.1	< 0.20

Table 4-2

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
11-13 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		11-13 Tufts Street (continued)							
		11/13TUFTS-1 9/28/06 GEI		11/13TUFTS-B 9/28/06 GEI		11/13 TUFTS-1 12/15/06 GEI		11/13 TUFTS-B 12/15/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:							
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.62 J	0.099 J	0.69 J	0.11 J
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT
Chloromethane		NT	NT	NT	NT	NT	NT	NT	NT
Methylene chloride		NT	NT	NT	NT	NT	NT	NT	NT
1,1,2,2-Tetrachloroethane		<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20
Tetrachloroethylene (PCE)		1.5	0.22	0.88 J	0.13 J	< 1.4	< 0.20	2.2	0.33
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "≤" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-3

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
17 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By: Units:		17 Tufts Street							
		IA-12 (1) 3/24/05 Shaw		IA-11 (B) 3/24/05 Shaw		17TUFTS-1 3/24/06 GEI		17TUFTS-B 3/24/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15	NT	NT	NT	NT	< 1.3	< 0.20	< 1.3	< 0.20
		1.9	0.39	1.1	0.23	< 0.98	< 0.20	< 0.98	< 0.20
		1.1	0.52	0.97	0.47	1.7 G	0.80 G	1.2 G	0.58 G
		1.0	0.3	1.5	0.43	4.2 J+	1.2 J+	59.1 G	17.0 G
		4.7	0.69	8.8	1.3	2.9	0.43	1.3 J	0.19 J
		< 1.1	< 0.20	0.91 J	0.17 J	< 1.1	< 0.20	< 1.1	< 0.20

Table 4-3
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
17 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		17 Tufts Street (continued)							
		17TUFTS-C (FD of B)		17TUFTS-1		17TUFTS-B		17TUFTS-C (FD of B)	
		3/24/06 GEI		10/2/06 GEI		10/2/06 GEI		10/2/06 GEI	
Analyte	Method	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Chloroform		< 0.98	< 0.20	NT	NT	NT	NT	NT	NT
Chloromethane		1.4 G	0.69 G	NT	NT	NT	NT	NT	NT
Methylene chloride		57.3 G	16.5 G	NT	NT	NT	NT	NT	NT
Tetrachloroethylene (PCE)		1.4	0.21	0.88 J	0.13 J	6.1	0.90	6.0	0.89
Trichloroethylene (TCE)		0.70 J	0.13 J	< 1.1	< 0.20	7.0	1.3	7.0	1.3

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. C = Duplicate of Basement (B) samples.
8. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-3
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
17 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		17 Tufts Street (continued)					
		17 TUFTS-1 12/18/06 GEI		17 TUFTS-B 12/18/06 GEI		17 TUFTS-C 12/18/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:					
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		0.57 J	0.090 J	0.52 J	0.083 J	< 1.3	< 0.20
Chloroform		NT	NT	NT	NT	NT	NT
Chloromethane		NT	NT	NT	NT	NT	NT
Methylene chloride		NT	NT	NT	NT	NT	NT
Tetrachloroethylene (PCE)		1.5	0.22	2.0	0.30	< 1.4	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	0.70 J	0.13 J	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. C = Duplicate of Basement (B) samples.
8. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-4

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
19 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		19 Tufts Street									
		IA-14 (1) 3/24/05 Shaw		IA-13 (B) 3/24/05 Shaw		19TUFTS-1 3/23/06 GEI		19TUFTS-B 3/23/06 GEI		19TUFTS-C 3/23/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:									
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		0.78 J	0.16 J	< 0.98	< 0.20	< 0.98	< 0.20	< 0.98	< 0.20	< 0.98	< 0.20
		1.1	0.52	0.85	0.41	21.7 G	10.5 G	1.8 G	0.88 G	1.8 G	0.85 G
		0.34 J	0.099 J	0.35 J	0.1 J	4.2 J+	1.2 J+	3.2 J+	0.92 J+	4.2 J+	1.2 J+
		0.95 J	0.14 J	3.2	0.47	1.2	0.18	7.5	1.1	6.6	0.98
< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	

General Notes:

- IRA = Immediate Response Action.
- Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
- µg/m³ = micrograms per cubic meter.
- ppbv = parts per billion by volume.
- "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
- NT = Not Tested.
- C = Duplicate of Basement (B) samples.
- Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-4
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
19 Tufts Street
Somerville, Massachusetts

Analyte		19 Tufts Street (continued)									
		Sample Location:		19 TUFTS-1		19 TUFTS-B		19 TUFTS-C		19TUFTS-1	
		Sample Name:		6/29/06		6/29/06		6/29/06		10/10/06	
		Sample Date:		GEI		GEI		GEI		GEI	
		Collected By:									
		Units:									
		Method									
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride											
Chloroform											
Chloromethane											
Methylene chloride											
Tetrachloroethylene (PCE)											
Trichloroethylene (TCE)											

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. C = Duplicate of Basement (B) samples.
8. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-4

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
19 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		19 Tufts Street (continued)							
		19 TUFTS-C 10/10/06 GEI		19 TUFTS-1 12/15/06 GEI		19 TUFTS-B 12/15/06 GEI		19 TUFTS-C 12/15/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:							
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	0.63 J	0.10 J	0.59 J	0.093 J	< 1.3	< 0.20
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT
Chloromethane		NT	NT	NT	NT	NT	NT	NT	NT
Methylene chloride		NT	NT	NT	NT	NT	NT	NT	NT
Tetrachloroethylene (PCE)		6.8	1.0	0.60 J	0.089 J	2.5	0.37	1.4	0.20
Trichloroethylene (TCE)		6.4	1.2	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. C = Duplicate of Basement (B) samples.
8. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-5
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
25 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		25 Tufts Street					
		IA-3 (1) 2/23/05 Shaw		IA-4 (B) 2/23/05 Shaw		25TUFTS-1 3/23/06 GEI	
		25TUFTS-B 3/23/06 GEI					
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	Carbon tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
	Chloroform	2	0.4	< 0.98	< 0.20	< 0.98	< 0.20
	Chloromethane	0.95	0.46	0.74	0.36	1.1 G	0.54 G
	Methylene chloride	< 1.4 J+	< 0.20 J+	0.49 J	0.14 J	1.9 J+	0.54 J+
Tetrachloroethylene (PCE)		< 1.1	< 0.20	1.6	0.23	1.7	0.25
Analyte	Method						
TO-15							

- General Notes:**
1. IRA = Immediate Response Action.
 2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
 3. µg/m³ = micrograms per cubic meter.
 4. ppbv = parts per billion by volume.
 5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
 6. NT = Not Tested.
 7. Samples from 2005 were collected by Shaw Environmental, Inc.

- Qualifying Notes:**
- G The result is estimated due to duplicate precision outside control limits.
 - J The reported result is below the laboratory reporting limit and is estimated.
 - J+ The reported result is estimated.

Table 4-5

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
25 Tufts Street
Somerville, Massachusetts

25 Tufts Street (continued)																		
Sample Location: Sample Name: Sample Date: Collected By: Units:		25TUFTS-1 8/1/06 GEI		25TUFTS-B 8/1/06 GEI		25TUFTS-1 10/2/06 GEI		25TUFTS-B 10/2/06 GEI										
		µg/m ³		ppbv		µg/m ³		ppbv		µg/m ³		ppbv						
Analyte	Method																	
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE)	TO-15																	
			< 1.3 NT NT NT 2.0		< 0.20 NT NT NT 0.29		< 1.3 NT NT NT 3.9		< 0.20 NT NT NT 0.57		< 1.3 NT NT NT < 1.4		< 0.20 NT NT NT < 0.20		< 1.3 NT NT NT 4.2		< 0.20 NT NT NT 0.62	

Table 4-5

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment

25 Tufts Street
Somerville, Massachusetts

Sample Location:			25 Tufts Street (continued)			
Sample Name:			25 TUFTS-1		25 TUFTS-B	
Sample Date:			12/15/06		12/15/06	
Collected By:			GEI		GEI	
Analyte	Method	Units:	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	TO-15		0.63 J	0.10 J	0.56 J	0.089 J
Chloroform			NT	NT	NT	NT
Chloromethane			NT	NT	NT	NT
Methylene chloride			NT	NT	NT	NT
Tetrachloroethylene (PCE)			1.7	0.25	6.6	0.97

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
6. NT = Not Tested.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Table 4-6

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment

49 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By: Units:		49 Tufts Street					
		49TUFTS-1 9/6/07 GEI		49TUFTS-B 9/6/07 GEI		49TUFTS-1 2/19/09 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		1.0 J	0.16 J	0.94 J	0.15 J	< 1.3	< 0.20
1,2-Dichloroethane (DCA)		0.45 J	0.11 J	< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)		1.8	0.27	1.8	0.27	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		0.60 J	0.11 J	0.42 J	0.077 J	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-6

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
49 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		49 Tufts Street (continued)							
		49TUFTS-1 9/1/09 GEI		49TUFTS-B 9/1/09 GEI		49TUFTS-1 3/9/10 GEI		49TUFTS-B 3/9/10 GEI	
		$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Analyte	Method	Units:							
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	1.5	0.24	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane (DCA)		< 0.81	< 0.20	< 0.81	< 0.20	0.69 J	0.17 J	< 0.81	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	1.1 J	0.16 J	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	0.97 J	0.18 J	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-7

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

12-14 Knowlton Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		12-14 Knowlton Street					
		12-14KNOW1 6/14/07		12-14KNOWB 6/14/07		12-14KNOW-1 11/13/07	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	0.62 J	0.099 J	0.63 J	0.10 J
1,2-Dichloroethane (DCA)		< 0.81	< 0.20	0.40 J	0.099 J	< 0.81	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	1.0 J G	0.15 J G	< 1.4	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The report is estimated due to duplicate precision outside control limits.

Table 4-7

Chemical Testing Results - Indoor Air
 IRA Completion Report Amendment
 12-14 Knowlton Street
 Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		12-14 Knowlton Street (continued)							
		12-14KNOW-1 8/4/08		12-14KNOW-B 8/4/08		14KNOW-1 1/19/09		14KNOW-B 1/19/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane (DCA) Tetrachloroethylene (PCE)	TO-15	0.69 J	0.11 J	0.82 J	0.13 J	0.62 J	0.098 J	0.63 J	0.10 J
		1.6	0.39	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		< 1.4	< 0.20	< 1.4	< 0.20	1.2 J	0.17 J	1.2 J	0.18 J

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The report is estimated due to duplicate precision outside control limits.

Table 4-8

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

97 Franklin Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		97 Franklin Street							
		97FRAN-1 9/29/07		97FRAN-B 9/29/07		97FRAN-1 2/21/08		97FRAN-B 2/21/08	
		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
		Method							
Analyte	Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane (DCA) Tetrachloroethylene (PCE)	TO-15							
				< 1.3 < 0.81 < 1.4		< 0.20 < 0.20 < 0.20		< 1.3 < 0.81 < 1.4	
				< 1.3 < 0.81 < 1.4		< 0.20 < 0.20 < 0.20		< 1.3 < 0.81 < 1.4	
				< 1.3 < 0.81 < 1.4		< 0.20 < 0.20 < 0.20		< 1.3 < 0.81 < 1.4	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	
				< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20		< 0.20 < 0.20 < 0.20	

Table 4-8
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
97 Franklin Street
Somerville, Massachusetts

Analyte		97 Franklin Street (continued)									
		Sample Location:		97FRAN-1 7/24/08		97FRAN-B 7/24/08		97FRAN-1 1/14/09		97FRAN-B 1/14/09	
		Sample Name: Sample Date:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method		Units:									
TO-15											
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride		0.69 J	0.11 J	0.69 J	0.11 J	0.63 J	0.10 J	0.75 J	0.12 J		
1,2-Dichloroethane (DCA)		11	2.6	0.81	0.20	< 0.81	< 0.20	< 0.81	< 0.20		
Tetrachloroethylene (PCE)		< 1.4	< 0.20	1.3 J	0.19 J	< 1.4	< 0.20	0.81 J	0.12 J		

- General Notes:**
- IRA = Immediate Response Action.
 - Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
 - µg/m³ = micrograms per cubic meter.
 - ppbv = parts per billion by volume.
 - "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:
J The reported result is below the laboratory reporting limit and is estimated.

Table 4-8

Chemical Testing Results - Indoor Air
 IRA Completion Report Amendment
 97 Franklin Street
 Somerville, Massachusetts

97 Franklin Street (continued)				
Sample Location:		97FRAN-B 3/8/10		
Sample Name:		97FRAN-1 3/8/10		
Sample Date:				
Units:		µg/m ³	ppbv	ppbv
Analyte	Method			
Volatile Organic Compounds (VOCs)	TO-15			
		Carbon tetrachloride	< 0.20	< 1.3
		1,2-Dichloroethane (DCA)	< 0.20	< 0.81
		Tetrachloroethylene (PCE)	0.15 J	1.6
		< 1.3		< 0.20
		< 0.81		< 0.20
		1.0 J		0.23

Table 4-9

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

99 Franklin Street

Somerville, Massachusetts

Analyte		99 Franklin Street					
		Sample Location:		99FRANK-B		99FRANK-1	
		Sample Name:		6/25/07		2/5/08	
		Sample Date:		ppbv		ppbv	
Units:				µg/m ³		µg/m ³	
Method							
TO-15							
Volatile Organic Compounds (VOCs)							
Tetrachloroethylene (PCE)				1.4		0.21	
				1.2 J		0.17 J	
				8.1		1.2	
				< 1.4		< 0.20	

General Notes

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-10

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

162-164 Glen Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units: Method		162-164 Glen Street					
		162GLEN-1 8/13/07		162GLEN-B 8/13/07		162GLEN-1 1/28/10	
		162GLEN-1 8/13/07		162GLEN-B 8/13/07		162GLEN-1 1/28/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride Dichloroethane, 1,2- Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA)	TO-15	0.63 J	0.10 J	0.69 J	0.11 J	< 1.3	< 0.20
		0.65 J	0.16 J	2.5	0.61	< 0.81	< 0.20
		2.8	0.41	3.7	0.54	< 1.4	< 0.20
		0.53 J	0.097 J	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-10

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
162-164 Glen Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		162-164 Glen Street					
		162-164-GLEN-1 11/19/10		162-164-GLEN-B 11/19/10		162-164-GLEN-1 2/4/11	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	NT	NT
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-11

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

16-20 Alston Street

Somerville, Massachusetts

Sample Location:		16-20 Alston Street			
Sample Name:		16ALST-1		16ALST-B	
Sample Date:		8/10/2007		8/10/2007	
Units:		µg/m³		ppbv	
Method		µg/m³		ppbv	
TO-15		0.61 J		0.82 J	
		0.95 J		1.6	
		4.8		0.60 J	
Volatile Organic Compounds (VOCs)		0.097 J		0.13 J	
Carbon tetrachloride		0.14 J		0.23	
Tetrachloroethylene (PCE)		0.88		0.11 J	
1,1,1-Trichloroethane (TCA)					

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-12

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
76 Franklin Street
Somerville, Massachusetts

Analyte		Sample Location: 76 Franklin Street - 1st Floor					
		Sample Name: 76FRAN-1		Sample Date: 2/11/08		76FRAN-1 6/24/08	
		Sample Date: 11/5/07		ppbv		µg/m³	
		Units: µg/m³		ppbv		ppbv	
Method							
Volatile Organic Compounds (VOCs)		TO-15					
Carbon tetrachloride		0.62 J 1.4	0.099 J 0.2	0.62 J < 1.4	0.98 J < 0.20	< 1.3 < 1.4	< 0.20 < 0.20
Tetrachloroethylene (PCE)							

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The report result is estimated.

Table 4-12
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
76 Franklin Street
Somerville, Massachusetts

Analyte	Sample Location: Sample Name: Sample Date: Units:	76 Franklin Street - Basement					
		76FRAN-B 11/5/07		76FRAN-B 2/11/08		76FRAN-B 6/24/08	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)	Method TO-15	< 1.3	< 0.20	0.63 J, J+	0.10 J, J+	< 1.3	< 0.20
		< 1.4	< 0.20	< 1.4 J+	< 0.20 J+	< 1.4	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The report result is estimated.

Table 4-13
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
45-47 Tufts Street, Units #1 and #4
Somerville, Massachusetts

Sample Location:			45-47 Tufts Street, Unit 1											
Sample Name:			45-47TUFT-1		45-47TUFT-B		45TUFTNO1-1		45TUFTNO1-B		45TUFT-1		45TUFT-B	
Sample Date:			7/25/08		7/25/08		12/11/08		12/11/08		6/3/09		6/3/09	
Units:			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method														
Analyte	TO-15													
	Volatile Organic Compounds (VOCs)													
	Carbon tetrachloride		0.63 J	0.10 J	0.62 J	0.098 J	0.62 J	0.098 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
	1,2-Dichloroethane (DCA)		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	1.7	0.42	< 0.81	< 0.20
	Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.1	0.20	< 1.1	< 0.20	

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-13
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
45-47 Tufts Street, Units #1 and #4
Somerville, Massachusetts

Sample Location:		45-47 Tufts Street, Unit 4									
		Sample Name:		Sample Date:		Units:		Method			
		47TUFTU4-1		47TUFTU4-B		47TUFTS04-1		47TUFTS04-B		47TUFT-1	
		10/7/08	10/7/08	10/7/08	10/7/08	1/16/09	1/16/09	1/16/09	1/16/09	6/2/09	6/2/09
Analyte		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride	TO-15	< 1.3	< 0.20	0.59 J	0.093 J	0.59 J	0.093 J	0.57 J	0.091 J	< 1.3	< 0.20
1,2-Dichloroethane (DCA)		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.38	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	0.95 J	0.14 J	< 1.4	< 0.20	< 1.4	< 0.20	< 0.20	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.0 J	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-14

Chemical Testing Results - Indoor Air
 IRA Completion Report Amendment
 51-51A Tufts Street
 Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		51-51A Tufts Street					
		51TUFT-1 7/25/08 GEI		51TUFT-B 7/25/08 GEI		51TUFT-1 12/11/08 GEI	
		ppbv		ppbv		ppbv	
		µg/m ³		µg/m ³		µg/m ³	
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		0.69 J		0.63 J		0.60 J	
1,2-Dichloroethane (DCA)		17		1.1		1.6	
Tetrachloroethylene (PCE)		0.75 J		0.88 J		< 1.4	
		0.11 J		0.10 J		0.095 J	
		4.1		0.28		0.40	
		0.11 J		0.13 J		< 0.20	
						0.60 J	
						< 0.81	
						< 1.4	
						0.096 J	
						< 0.20	
						< 0.20	

General Notes:

1. IRA = Immediate Response Action.
2. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
3. µg/m³ = micrograms per cubic meter.
4. ppbv = parts per billion by volume.
5. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-14
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
51-51A Tufts Street
Somerville, Massachusetts

51-51A Tufts Street (continued)									
Analyte	Sample Location: Sample Name: Sample Date: Collected By: Units:	51TUFT-1 6/3/09 GEI		51TUFT-B 6/3/09 GEI		51TUFT-1 3/3/10 GEI		51TUFT-B 3/3/10 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		1.3	0.33	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		1.2 J	0.17 J	< 1.4	< 0.20	1.6	0.24	< 1.4	< 0.20
Method		TO-15							
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride									
1,2-Dichloroethane (DCA)									
Tetrachloroethylene (PCE)									

Table 4-15

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
19-19A Morton Street
Somerville, Massachusetts

Analyte		Location Name: Sample Name: Sample Date: Units:		Post-EPEM 19-19A Morton Street							
				19MORT-1 9/3/09		19MORT-B 9/3/09		19MORT-1 1/29/10		19MORT-B 1/29/10	
				µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		Method TO-15									
Carbon tetrachloride				< 1.3		< 1.3		< 1.3		< 1.3	
1,2-Dichloroethane (DCA)				< 0.81		< 0.81		< 0.81		< 0.81	
Tetrachloroethylene (PCE)				< 1.4		< 1.4		< 1.4		< 1.4	

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
4. µg/m³ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. The samples collected in September 2009 were collected over a 24-hour period from September 3 to 4, 2009.
8. The samples collected in January 2010 were collected over a 24-hour period from January 28 to 29, 2010.
9. The samples collected in December 2010 were collected over a 24-hour period from December 6 to 7, 2010.
10. NT = Not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Table 4-15

Chemical Testing Results - Indoor Air

IRA Completion Report Amendment

19-19A Morton Street

Somerville, Massachusetts

Post-EPEM 19-19A Morton Street					
Location Name:		19MORT-1 12/7/10		19MORT-B 12/7/10	
Sample Name:					
Sample Date:					
Units:		$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Analyte	Method				
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane (DCA) Tetrachloroethylene (PCE)	TO-15	NT	NT	NT	NT
		NT	NT	NT	NT
		3.1	0.45	4.8	0.71

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets
4. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. The samples collected in September 2009 were collected over a 24-hour period from September 3 to 4, 2009.
8. The samples collected in January 2010 were collected over a 24-hour period from January 28 to 29, 2010.
9. The samples collected in December 2010 were collected over a 24-hour period from December 6 to 7, 2010.
10. NT = Not tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-16

Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
10 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date:		10 Morton Street post-EPEM							
		10MORT-1 4/3/09		10MORT-B 4/3/09		10MORT-1 2/12/10		10MORT-B 2/12/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:							
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
4. µg/m³ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. EPEM = Exposure Pathway Elimination Measure.
8. The samples collected in February 2010 were collected over a 24-hour period from February 11 through 12, 2010.
9. The samples collected in November 2010 were collected over a 24-hour period from November 12 through 13, 2010.
10. The samples collected in December 2010 were collected over a 24-hour period from December 17 through 18, 2010.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-16
Chemical Testing Results - Indoor Air
IRA Completion Report Amendment
10 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		10 Morton Street post-EPEM (continued)					
		10MORT-1 11/19/10		10MORT-B 11/19/10		10MORT-1 12/18/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		NT	NT	NT	NT	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		2.9	0.54	13	2.4	1.4	0.26

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
4. µg/m³ = micrograms per cubic meter.
5. ppbv = parts per billion by volume.
6. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
7. EPEM = Exposure Pathway Elimination Measure.
8. The samples collected in February 2010 were collected over a 24-hour period from February 11 through 12, 2010.
9. The samples collected in November 2010 were collected over a 24-hour period from November 12 through 13, 2010.
10. The samples collected in December 2010 were collected over a 24-hour period from December 17 through 18, 2010.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Table 4-17

Option 3 EPEM Installation and Operational Costs
 IRA Completion Report Amendment
 12-14 Knowlton Street
 Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Option 3 EPEM -- Installation					
<i>Engineering Design</i>					
	Vapor pit/piping layout, drawings, testing	Lump Sum	\$2,040	1	\$2,040
	Meetings, coordination, documentation	Lump Sum	\$1,960	1	\$1,960
<i>Coordination and Oversight</i>					
	GEI labor	Lump Sum	\$2,960	1	\$2,960
<i>Installation</i>					
	Mobilization and basement preparation	Lump Sum	\$1,900	1	\$1,900
	Demolition and excavation	Lump Sum	\$7,100	1	\$7,100
	EPEM component installation	Lump Sum	\$26,000	1	\$26,000
	Plumbing and heating	Lump Sum	\$1,300	1	\$1,300
	Carpentry	Lump Sum	\$5,300	1	\$5,300
	Furnace replacement	Lump Sum	\$5,000	3	\$15,000
	Hot water heater replacement	Lump Sum	\$2,000	3	\$6,000
	Crawl space	Lump Sum	\$10,000	0	\$0
	Contractor overhead/foreman oversight	Lump Sum	\$12,400	1	\$12,400
				Sub-Total:	\$81,960
Option 3 EPEM -- Reporting, Operation, Maintenance, and Monitoring					
<i>Closure Documentation</i>					
	GEI labor	Lump Sum	\$3,750	1	\$3,750
<i>Maintenance and Monitoring</i>					
	GEI check system, documentation	Year	\$1,160	30	\$34,800
				Sub-Total:	\$38,550
				Total:	\$120,510

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Does not include air sampling time or materials costs.

Table 4-18

Option 3 EPEM Installation and Operational Costs
IRA Completion Report Amendment
97 Franklin Street
Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Option 3 EPEM -- Installation					
	<i>Engineering Design</i>				
	Vapor pit/piping layout, drawings, testing	Lump Sum	\$2,040	1	\$2,040
	Meetings, coordination, documentation	Lump Sum	\$1,960	1	\$1,960
	<i>Coordination and Oversight</i>				
	GEI labor	Lump Sum	\$2,960	1	\$2,960
	<i>Installation</i>				
	Mobilization and basement preparation	Lump Sum	\$1,900	1	\$1,900
	Demolition and excavation	Lump Sum	\$5,700	1	\$5,700
	EPEM component installation	Lump Sum	\$20,500	1	\$20,500
	Plumbing and heating	Lump Sum	\$1,300	1	\$1,300
	Carpentry	Lump Sum	\$5,300	1	\$5,300
	Furnace replacement	Lump Sum	\$5,000	1	\$5,000
	Hot water heater replacement	Lump Sum	\$2,000	1	\$2,000
	Crawl space	Lump Sum	\$10,000	0	\$0
	Contractor overhead/foreman oversight	Lump Sum	\$8,300	1	\$8,300
				Sub-Total:	\$56,960
Option 3 EPEM -- Reporting, Operation, Maintenance, and Monitoring					
	<i>Closure Documentation</i>				
	GEI labor	Lump Sum	\$3,750	1	\$3,750
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation	Year	\$1,160	30	\$34,800
				Sub-Total:	\$38,550
				Total:	\$95,510

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Does not include air sampling time or materials costs.

Table 4-19

Option 3 EPEM Installation and Operational Costs
IRA Completion Report Amendment
162-164 Glen Street
Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Option 3 EPEM -- Installation	<i>Engineering Design</i>				
	Vapor pit/piping layout, drawings, testing	Lump Sum	\$2,040	1	\$2,040
	Meetings, coordination, documentation	Lump Sum	\$1,960	1	\$1,960
	<i>Coordination and Oversight</i>				
	GEI labor	Lump Sum	\$2,960	1	\$2,960
	<i>Installation</i>				
	Mobilization and basement preparation	Lump Sum	\$1,900	1	\$1,900
	Demolition and excavation	Lump Sum	\$10,300	1	\$10,300
	EPEM component installation	Lump Sum	\$37,400	1	\$37,400
	Plumbing and heating	Lump Sum	\$1,300	1	\$1,300
	Carpentry	Lump Sum	\$5,300	1	\$5,300
	Furnace replacement	Lump Sum	\$5,000	3	\$15,000
	Hot water heater replacement	Lump Sum	\$2,000	3	\$6,000
	Crawl space	Lump Sum	\$10,000	0	\$0
	Contractor overhead/foreman oversight	Lump Sum	\$15,400	1	\$15,400
				Sub-Total:	\$99,560
Option 3 EPEM -- Reporting, Operation, Maintenance, and Monitoring	<i>Closure Documentation</i>				
	GEI labor	Lump Sum	\$3,750	1	\$3,750
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation	Year	\$1,160	30	\$34,800
				Sub-Total:	\$38,550
				Total:	\$138,110

General Notes:

1. IRA = Immediate Response Action.
2. EPEM = Exposure Pathway Elimination Measure.
3. Does not include air sampling time or materials costs.

Table 4-20
Modify Existing Passive EPEM to Active SSDS
IRA Completion Report Amendment
19-19A Morton Street
Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Upgrade to Active SSDS -- Installation	<i>Engineering Design</i>				
	Data review, fan selection, testing	Lump Sum	\$1,440	1	\$1,440
	Meetings, coordination, documentation	Lump Sum	\$3,080	1	\$3,080
	<i>Installation</i>				
	RadonAway GP501 fan	each	\$239	1	\$239
	Install electrical panel, meter, service	each	\$1,000	1	\$1,000
	Installation Labor	hour	\$50	8	\$400
	Foreman oversight	hour	\$80	4	\$320
	Miscellaneous (tools, trucks, mobilization, etc.)	Lump Sum	\$250	1	\$250
				Sub-Total:	\$6,729
Option 1 (SSDS) -- Operation, Maintenance, and Monitoring					
	<i>Operation</i>				
	Annual electrical costs	Year	\$219	30	\$6,570
	<i>Maintenance and Monitoring</i>				
	GEI check system, documentation, reporting	Year	\$1,160	30	\$34,800
				Sub-Total:	\$41,370
				Total:	\$48,099

General Notes:

1. EPEM = Exposure Pathway Elimination Measure.
2. SSDS = Sub-Slab Depressurization System.
3. IRA = Immediate Response Action.
4. The above costs assume that no modifications will be made to the existing piping layout or other EPEM components.
5. Does not include air sampling time + materials or reporting costs.

Table 4-21

Modify Existing Passive EPEM to Active SSDS

IRA Completion Report Amendment

10 Morton Street

Somerville, Massachusetts

EPEM Type	Activity	Unit	Unit Cost	Quantity	Cost
Upgrade to Active SSDS -- Installation					
<i>Engineering Design</i>					
	Data review, fan selection, testing	Lump Sum	\$1,440	1	\$1,440
	Meetings, coordination, documentation	Lump Sum	\$3,080	1	\$3,080
<i>Installation</i>					
	RadonAway GP501 fan	each	\$239	1	\$239
	Install electrical panel, meter, service	each	\$1,000	1	\$1,000
	Installation Labor	hour	\$50	8	\$400
	Foreman oversight	hour	\$80	4	\$320
	Miscellaneous (tools, trucks, mobilization, etc.)	Lump Sum	\$500	1	\$500
				Sub-Total:	\$6,979
Option 1 (SSDS) -- Operation, Maintenance, and Monitoring					
<i>Operation</i>					
	Annual electrical costs	Year	\$219	30	\$6,570
<i>Maintenance and Monitoring</i>					
	GEI check system, documentation, reporting	Year	\$1,160	30	\$34,800
				Sub-Total:	\$41,370
				Total:	\$48,349

General Notes:

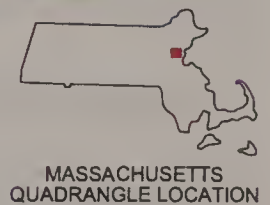
1. EPEM = Exposure Pathway Elimination Measure.
2. SSDS = Sub-Slab Depressurization System.
3. IRA = Immediate Response Action.
4. The above costs assume that no modifications will be made to the existing piping layout or other EPEM components.
5. Does not include air sampling time + materials or reporting costs.

MassDEP RTN 3-23246
Immediate Response Action Completion Report
Amendment
50 Tufts Street, Somerville, Massachusetts
UniFirst Corporation
April 1, 2011

Figures



0 1000 2000 4000 6000
SCALE, FEET



This Image provided by MassGIS is taken from
U.S.G.S. Topographic 7.5 X 15 Minute Series
Boston North, MA Quadrangle, 1985.
Datum is National Geodetic Vertical Datum (NGVD 1929).
Contour Interval is 3 Meters.

IRA Completion Report Amendment
50 Tufts Street
Somerville, Massachusetts

UniFirst Corporation
Wilmington, Massachusetts



Project 04516-3

SITE LOCATION MAP

April 2011

Fig. 1-1

Appendix A

NOAF and NON from MassDEP



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

Certified Mail

February 1, 2011

Unifirst Corporation
68 Jonspin Road
Wilmington, MA 01887
ATTN: Mr. John R. Badey

RE: Somerville
50 Tufts Street
RTN 3-23246
IRAC Invalidation
NON-NE-11-3S004

**NOTICE OF AUDIT FINDINGS
NOTICE OF NONCOMPLIANCE
IMMEDIATE RESPONSE ACTION COMPLETION STATEMENT NOT VALID**

Dear Mr. Badey:

The Massachusetts Department of Environmental Protection (MassDEP) has conducted an audit of the Immediate Response Action Completion statement (IRAC) filed for the above-referenced site (the Site), which is identified by Release Tracking Number 3-23246. The IRAC Statement, received on November 16, 2009, was prepared on your behalf (as used in this Notice, "you" refers to UniFirst Corporation) by GEI Consultants, Inc. (GEI), Ileen Gladstone, LSP #9719.

FINDINGS

IRAC Not Valid As a result of the audit, MassDEP has determined that response actions were not performed in compliance with the requirements of the Massachusetts Contingency Plan (MCP) and, therefore, the IRAC submittal is not valid. Violations were identified that require additional actions to be taken under the supervision of an LSP in order to come into compliance with the MCP.

The Notice of Noncompliance (Attachment A) describes: (1) each activity identified during the audit which is in noncompliance, (2) the requirements violated, (3) the actions MassDEP now wants you to take, and (4) the deadlines for taking these actions.

The Audit Memorandum (Attachment B) describes the activities MassDEP personnel performed during the audit and summarizes relevant site information.

You do not need further MassDEP approval to take the actions MassDEP has specified.

LICENSED SITE PROFESSIONAL

A copy of this Notice has been sent to Ileen Gladstone (LSP #9719). Please note that you, not your LSP, are responsible for responding to this Notice of Noncompliance and correcting the violations identified herein.

LIMITATIONS

MassDEP's findings were based upon the certainty of the information reviewed during the audit. These findings do not: (1) apply to actions or other aspects of the site that were not reviewed in the audit, (2) preclude future audits of past, current, or future actions at the site, (3) in any way constitute a release from any liability, obligation, action or penalty under M.G.L. c. 21E, 310 CMR 40.0000, or any other law, regulation, or requirement, or (4) limit the MassDEP's authority to take or arrange, or to require any Responsible Party or Potentially Responsible Party to perform, any response action authorized by M.G.L. c. 21E which the MassDEP deems necessary to protect health, safety, public welfare, or the environment.

If you have any questions regarding this Notice, contact Andrew Friedmann at (978) 694-3217. Please reference the Release Tracking Number 3-23246 in any future correspondence to MassDEP regarding the site.

Sincerely,

This electronic copy is being provided as a cost-saving measure. A signed final version of this document is available for review at the Department.

e-signature

Stephen M. Johnson

Stephen M. Johnson
Deputy Regional Director
Bureau of Waste Site Cleanup

Cc: Data Entry, AUDCOM/NAFNON/IRA/INVSUB
Cc: (electronically): Somerville Board of Health
Ileen Gladstone, LSP (igladstone@geiconsultants.com)

Attachments A: Notice of Noncompliance
B: Audit Memorandum

Attachment A

NOTICE OF NONCOMPLIANCE

Somerville – 50 Tufts Street RTN 3-23246

PERSON/ENTITY IN NONCOMPLIANCE

Unifirst Corporation, 68 Jonspin Road, Wilmington, MA

LOCATION WHERE NONCOMPLIANCE OCCURRED OR WAS OBSERVED

50 Tufts Street, Somerville, MA

DATE WHEN NONCOMPLIANCE OCCURRED OR WAS OBSERVED

November 16, 2009, the receipt date of the Immediate Response Action Completion (IRAC) Statement

DESCRIPTION OF REQUIREMENTS NOT COMPLIED WITH

1. Violation: 310 CMR 40.0414(3) – Scope and Types of Immediate Response Actions

310 CMR 40.0414(3)(b) and (c) state, in part, that Immediate Response Actions shall be presumed to require the elimination and/or mitigation of Critical Exposure Pathways (CEPs) to the extent feasible.

Several residential properties have CEPs that have not been eliminated or mitigated to the extent feasible, either because a mitigation system was not offered or the mitigation system that was installed has not been demonstrated to be effective.

GEI asserted that it is infeasible to mitigate a CEP when the indoor air contaminant levels are consistent with a condition of No Significant Risk. Based on this assertion, mitigation systems were not offered to the following four residential buildings:

- 23 Knowlton Street;
- 6-8 Morton Street;
- 105-107 Washington Street; and
- 111 Washington Street.

The requirement to eliminate, mitigate or prevent a CEP applies regardless of the quantitative level of risk. Determination of a condition of NSR is not, in and of itself, sufficient justification to conclude that elimination or mitigation of a CEP is not feasible.

In addition to the buildings listed above, the effectiveness of passive mitigation systems in the residential buildings listed below has not been demonstrated:

- 17 Knowlton Street;
- 4 Morton Street; and
- 27 Tufts Street.

For these residences, PCE has been detected in indoor air in one or more post-mitigation sampling rounds. The presence of PCE indicates the CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted.

2. Violation: 310 CMR 40.0993 (4) – Estimates of Potential Exposure

Per 310 CMR 40.0993(4), the magnitude of each receptor's total exposure to the oil and/or hazardous material at the disposal site is calculated in a manner which provides a conservative estimate of the potential exposures.

MassDEP assumes that a basement with 7 feet of headroom could potentially be used as a bedroom and therefore could be occupied by a receptor for up to twelve hours per day. The risk assessment used to support the IRAC (Appendix C of the IRAC Statement) assumed an exposure duration in the basement of four hours. This exposure assumption does not provide a conservative estimate for unrestricted use and cannot be used to support a conclusion of No Significant Risk.

ADDITIONAL COMMENT

Due to the relatively low cost of SSD systems, MassDEP considers installation of these systems feasible to mitigate or eliminate most CEP conditions caused by vapor intrusion. GEI has concluded that repeated trials at the site have demonstrated that conventional SSD systems have no utility. However, the pre- and post-mitigation indoor air data from on-site buildings that received conventional SSD systems indicate that the systems are effective in reducing or eliminating vapor intrusion (Table 1 in the Audit Memorandum).

DESCRIPTION OF REQUIRED ACTIONS

MassDEP hereby notifies you that the following response actions are necessary in order to bring the site back into compliance with the MCP:

1. An Immediate Response Action Plan Modification must be submitted within 60 days of the date of this letter and must include plans to eliminate or mitigate to the extent feasible CEPs at the following residences:
 - 17 Knowlton Street;
 - 23 Knowlton Street;
 - 4 Morton Street;
 - 6-8 Morton Street;
 - 27 Tufts Street;
 - 105-107 Washington Street; and
 - 111 Washington Street.

This plan should include a schedule of work to be done for each residence, and a schedule for additional indoor air sampling where needed.

As noted previously, in most cases MassDEP recommends the use of SSD systems to mitigate vapor intrusion. Prior to system installation, subslab quantitative diagnostic air flow and pressure testing can be used determine the most effective design for each building.

If a SSD system is installed, the primary performance standards used to confirm system effectiveness are the demonstration of a negative pressure field under the slab and the comparison of air sampling data collected before and after system installation.

2. An updated Risk Characterization must be submitted within 60 days of this letter for all residences impacted by vapor intrusion.

In order to demonstrate No Significant Risk for residential use, the appropriate exposure assumptions used in calculating an average daily exposure should be continuous exposure (24 hours per day, 365 days per year, for 30 years). These assumptions address the homebound adult and unrestricted use of the residence. If more than one EPC is developed for a building, such as an EPC for the basement and an EPC for the first floor, the exposure durations can be subdivided accordingly in order to estimate a time-weighted average daily dose. For residences, MassDEP recommends assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors, provided there is sufficient data to develop location-specific EPCs.

3. You must continue to implement Immediate Response Actions at the Site in compliance with the MCP until you can document that all CEPs have been eliminated or mitigated to the extent feasible.
4. After completion of these required activities, submit a Post-Audit Completion Statement, in accordance with 310 CMR 40.1170, to the MassDEP and to the attention of Andrew Friedmann. A copy of the Post-Audit Completion Statement is available at <http://mass.gov/dep/cleanup/approvals/trforms.htm>.

Attachment B

AUDIT MEMORANDUM

I. AUDIT ACTIVITIES

The audit consisted of the following activities:

- A review of the Immediate Response Action Completion Statement, received November 16, 2009 and other information in the MassDEP files.

II. SITE SUMMARY

The Site includes the 50 Tufts Street property (the Property), residential and commercial properties in the neighborhood to the east and west of the Property, and the Michael E. Capuano Early Childhood Center (Capuano Center). An approximately 20,594 ft² one-story building is located at 50 Tufts Street. The release of chlorinated volatile organic compounds (VOCs) into soil and groundwater is associated with the former use of this building as a dry cleaning supply repackaging and distribution facility. The facility operated from approximately 1955 through 2002.

The highest concentrations of chlorinated VOCs are located at 50 Tufts Street. Up to 52,000 ug/L of tetrachloroethylene (PCE), 220,000 ug/L trichloroethylene (TCE) and 290,000 ug/L 1,1,1-trichloroethane (TCA) were found in groundwater on the property. Groundwater depth at the site ranges from approximately 8.5 feet to 13 feet below ground surface. Overburden groundwater flow is toward the southeast.

Unifirst Corporation received a Notice of Responsibility from MassDEP dated November 9, 2005, and has been conducting response actions since March, 2006. In the NOR, MassDEP required an Immediate Response Action due to the detection of contamination near residential structures.

Immediate Response Actions

Response actions have included investigations into the nature and extent of contamination in groundwater, soil, soil gas, and indoor air at the 50 Tufts Street property, at 113 residences and commercial properties located in the neighborhood over the groundwater plume and at the Capuano Early Childhood Center.

GEI developed three remedial options to eliminate/mitigate vapor intrusion into the homes and businesses associated with the Tufts Street site:

- Option 1 is a conventional Sub-Slab Depressurization (SSD) system. These system follow a design similar to those commonly used for vapor mitigation. Sub-slab

vapors are pulled through a piping network by an in-line fan and discharged from an exhaust pipe above the roofline;

- Option 2 is a passive system with a vapor trench. This option is installed when there is a fieldstone or brick foundation, and poor sub-slab air flow. Option 2 consists of sealing the foundation walls with a vapor barrier system, installing a vapor trench around the basement perimeter, and sealing the floor with epoxy. A piping network connects the trench to an exhaust pipe above the roofline; and
- Option 3 is a passive system with the installation of a new floor. This option is installed for buildings with an incompetent concrete floor, fieldstone or brick foundation, and poor sub-slab air flow. Foundation walls are sealed with a vapor barrier system. The floor is removed, vapor sump systems are installed, and a new concrete floor is poured and sealed. Sub-slab pipes are connected to a piping network that discharges through a pipe above the roofline.

To date, vapor mitigation systems have been installed at 19 properties with a confirmed or likely Condition of Substantial Release Migration (SRM). Currently, eleven of these systems are passive and eight are active. The effectiveness of the active systems was assessed with between 1 and 7 rounds of indoor air testing, as well as the measurement of a negative pressure in the sub-slab relative to the indoor air. The effectiveness of the passive systems was assessed with between 1 and 5 rounds of indoor air testing.

Mitigation systems have not been installed in several of the buildings with SRM conditions. The IRAC stated that mitigation systems were not necessary in these buildings because a risk characterization performed by AMEC Earth and Environmental (AMEC) concluded a Condition of No Significant Risk exists or is likely to exist (dependent upon confirmatory indoor air sampling) at each location.

The Method 3 Risk Characterization performed by AMEC used both temporal and spatial averaging to estimate Exposure Point Concentrations (EPCs) for residences. For residences where 3 or more indoor air sampling rounds had been completed, the average value was used for the EPC. If there were fewer than 3 sampling rounds, the maximum detected value was used as the EPC. If a Contaminant of Potential Concern was not detected in the building, one-half the lowest laboratory reporting limit was used as the EPC. The time weighted average used to calculate the EPCs assumed 20 hours on the first floor and 4 hours in the basement.

Pre- and post-installation indoor air data is available from four on-site homes where “conventional” SSD systems were installed (Table 1). The data indicates these systems were effective at either mitigating or eliminating vapor intrusion.

Table 1
Concentrations of PCE ($\mu\text{g}/\text{m}^3$) in Basement Air of Homes with Conventional SSD Systems.

Address	Pre-SSDS Levels	Sampling Rounds	Post SSDS Levels	Sampling Rounds
95R Franklin Street	106	1	1.3 – 3.5	2
13 Knowlton Street	ND-6	2	ND	1
31-33 Knowlton Street	3-33	2	ND – 4.9	6
23 Tufts Street	2.3 – 125	6	ND – 1.4	5

In each of the above buildings, SSD systems appear to have significantly reduced the maximum concentration of PCE in indoor air. These data do not support the assertion that conventional SSD systems do not have “utility” for this site.

III. RISK ASSESSMENT

A Method 3 risk assessment was performed to estimate risks associated with exposure to contaminants of concern in soil, groundwater and indoor air. The risk assessment concluded that a Condition of No Significant Risk exists at 16 residential properties for both current and future unrestricted use. This conclusion is based on an assumed 4 hours per day exposure in residential basements.

IV. DETERMINATION

On the basis of the activities performed during the audit and in reliance upon the accuracy of that information, MassDEP makes the Determination that violations of the MCP were found in the actions audited, as outlined in Attachment A.

MassDEP RTN 3-23246
Immediate Response Action Completion Report
Amendment
50 Tufts Street, Somerville, Massachusetts
UniFirst Corporation
April 1, 2011

Appendix B

MassDEP Post-Audit Completion Statement (BWSC-111)



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC111

AUDIT FOLLOW-UP PLAN TRANSMITTAL FORM
& POST-AUDIT COMPLETION STATEMENT

Release Tracking Number

3

-

23246

Pursuant to 310 CMR 40.1160 - 40.1170 (Subpart K)

A. DISPOSAL SITE LOCATION:

1. Disposal Site Name: 50 TUFTS ST & PROP ACROSS THE ST

2. Street Address: 50 TUFTS ST

3. City/Town: SOMERVILLE

4. ZIP Code: 02145-4129

☒ 5. Check here if a Tier Classification Submittal has been provided to DEP for this disposal site.

☐ a. Tier 1A ☐ b. Tier 1B ☒ c. Tier 1C ☐ d. Tier 2

6. If a Tier I Permit has been issued, provide Permit Number: W085813

B. THIS FORM IS BEING USED TO: (check one)

☐ 1. Submit an **Audit Follow-Up Plan** (Section C is not required).

☐ 2. Submit a **Modified or Revised Audit Follow-Up Plan** (Section C is not required).

☒ 3. Submit a **Post-Audit Completion Statement**.

4. Provide Additional RTNs:

☐ a. Check here if this Audit Submittal covers additional Release Tracking Numbers (RTNs).

b. Provide the additional Release Tracking Number(s) covered by this Audit Submittal.

☐

-

☐

☐

-

☐

(All sections of this transmittal form must be filled out unless otherwise noted above)

C. POST-AUDIT RESPONSE ACTIONS SUMMARY:

1. Notice of Audit Finding Date Issued: 2/1/2011

mm/dd/yyyy

☒ 2. Documentation (check all that apply):

☒ a. Provided Technical Justification, or Supporting or Clarifying Information Relating to Previous Response Actions

☒ b. Performed Additional Risk Assessment

☐ c. Modified Disposal Site Boundary

☐ 3. Field Work (check all that apply):

☐ a. Sampled Previously Assessed Media (check all that apply):

☐ Soil

☐ GW

☐ SW

☐ Sediment

☐ Air

☐ Waste Material

☐ b. Sampled New Media Not Previously Assessed (check all that apply):

☐ Soil

☐ GW

☐ SW

☐ Sediment

☐ Air

☐ Waste Material

☐ c. Performed Remediation Describe:



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC111

AUDIT FOLLOW-UP PLAN TRANSMITTAL FORM
& POST-AUDIT COMPLETION STATEMENT

Release Tracking Number

3

-

23246

Pursuant to 310 CMR 40.1160 - 40.1170 (Subpart K)

C. POST-AUDIT RESPONSE ACTIONS SUMMARY: (cont.)

☒ 4. Outcome (Check all that apply and submit appropriate transmittal form(s)):

☐ a. Implemented or Amended Activity and Use Limitation

☒ b. Modified Risk Assessment Method

☐ c. Revised Response Action Outcome (RAO) Class

☐ d. Revised Tier Classification

☐ e. Revised or Modified Phase Work

☐ f. Retracted RAO Statement

☐ g. Other: _____

D. LSP SIGNATURE AND STAMP:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3), to the best of my knowledge, information and belief,

> if Section B of this form indicates that an **Audit Follow-up Plan**, or a **Modified or Revised Audit Follow-up Plan** is being submitted, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000 and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> if Section B of this form indicates that a **Post-Audit Completion Statement** is being submitted, the Post-Audit response action(s) that is (are) the subject of this submittal as required to correct either violations and/or deficiencies identified by DEP in a Notice of Audit Finding pursuant to 310 CMR 40.1140 (i) has (have) been developed, implemented and completed in accordance with the applicable provisions of M.G.L. c.21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c.21E and 310 CMR 40.0000 and (iii) complies(y) with the identified provisions of all orders, permits, approvals, or Audit Follow-up Plans pursuant to 310 CMR 40.1160 as identified in this submittal. Development, implementation and completion of the Post-Audit response action(s) have corrected the violations and/or deficiencies identified by DEP in the Notice of Audit Finding. This Statement does not (1) apply to actions or other aspects of the site that were not reviewed in the audit, (2) preclude future audits of past, current, or future actions at the site, (3) in any way constitute a release from any liability, obligation, action or penalty under M.G.L. c.21E, 310 CMR 40.0000, or any other law, regulation, or requirement, or (4) limit the Department's authority to take or arrange, or to require any Responsible Party or Potentially Responsible Party to perform, any response action authorized by M.G.L. c.21E, which the Department deems necessary to protect health, safety, public welfare or the environment.



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC111

AUDIT FOLLOW-UP PLAN TRANSMITTAL FORM
& POST-AUDIT COMPLETION STATEMENT

Release Tracking Number

3 - 23246

Pursuant to 310 CMR 40.1160 - 40.1170 (Subpart K)

D. LSP SIGNATURE AND STAMP: (cont.)

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

1. LSP #: 9719

2. First Name: ILEEN S

3. Last Name: GLADSTONE

4. Telephone: (781) 721-4012

5. Ext.:

6. FAX:

7. Signature: ILEEN S GLADSTONE

8. Date: 4/1/2011

mm/dd/yyyy

9. LSP Stamp:



E. PERSON RESPONDING TO AUDIT:

1. Check all that apply: ☐ a. change in contact name ☐ b. change of address ☐ c. change in the person undertaking response actions

2. Name of Organization: UNIFIRST CORPORATION

3. Contact First Name: JOHN R

4. Last Name: BADEY

5. Street: 68 JONSPIN RD

6. Title: VICE PRESIDENT

7. City/Town: WILMINGTON

8. State: MA

9. ZIP Code: 01887-1090

10. Telephone: (978) 658-8888

11. Ext.: 645

12. FAX: (978) 988-1305

F. RELATIONSHIP TO SITE OF PERSON RESPONDING TO AUDIT:

☒ 1. RP or PRP ☐ a. Owner ☐ b. Operator ☐ c. Generator ☐ d. Transporter

☒ e. Other RP or PRP Specify: OTHER PRPS

☐ 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ 4. Any Other Person Responding to Audit Specify Relationship:



Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC111

AUDIT FOLLOW-UP PLAN TRANSMITTAL FORM
& POST-AUDIT COMPLETION STATEMENT

Release Tracking Number

3

-

23246

Pursuant to 310 CMR 40.1160 - 40.1170 (Subpart K)

G. REQUIRED ATTACHMENT AND SUBMITTALS:

- ☐ 1. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.
- ☒ 2. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.

H. CERTIFICATION OF PERSON RESPONDING TO AUDIT:

1. I, , attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: Signature

3. Title: VICE PRESIDENT

4. For: UNIFIRST CORPORATION
(Name of person or entity recorded in Section E)

5. Date: 4/1/2011
mm/dd/yyyy

☐ 6. Check here if the address of the person providing certification is different from address recorded in Section E.

7. Street: _____

8. City/Town: _____ 9. State: _____ 10. ZIP Code: _____

11. Telephone: _____ 12. Ext.: _____ 13. FAX: _____

YOU MUST LEGIBLY COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY
RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU
MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

Date Stamp (DEP USE ONLY:)

Received by DEP on

4/1/2011 3:44:57 PM

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DEP Transaction ID: 373046

Date and Time Submitted: 4/1/2011 3:44:57 PM

Other Email :

Form Name: BWSC111 Audit Plan & Post-Audit Completion Statement

RTN: 3-23246

Location: 50 TUFTS ST & PROP ACROSS THE ST

Address: 50 TUFTS ST, SOMERVILLE, 021454129

Person Making Submittal

UNIFIRST CORPORATION

JOHN R BADEY

68 JONSPIN RD

WILMINGTON, MA 018871090

LSP

LSP #: 9719

LSP Name: ILEEN S GLADSTONE

Person Making Certification

UNIFIRST CORPORATION

John R Badey

Additional Forms Submitted

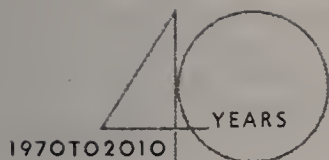
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MassDEP RTN 3-23246
Immediate Response Action Completion Report
Amendment
50 Tufts Street, Somerville, Massachusetts
UniFirst Corporation
April 1, 2011

Appendix C

Public Notice Letters



Geotechnical
Environmental
Water Resources
Ecological

April 1, 2011
Project 04516-3

Joseph A. Curtatone
Mayor, City of Somerville
Somerville City Hall
93 Highland Avenue
Somerville, MA 02143-1740

Dear Mayor Curtatone:

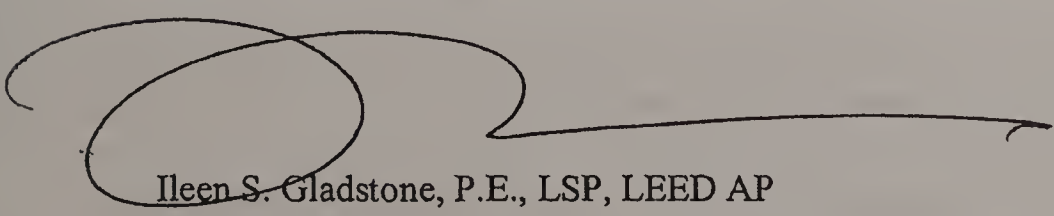
**Re: Immediate Response Action Completion Report Amendment
50 Tufts Street
Somerville, Massachusetts
MassDEP RTN 3-23246**

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, and in accordance with the Massachusetts Contingency Plan (MCP; 310 CMR 40.1403[3][c]), GEI Consultants, Inc. is notifying your office that an Immediate Response Action Completion Report Amendment (the Report), dated April 1, 2011, has been prepared for the 50 Tufts Street Site in Somerville, Massachusetts. The Report is available at the Massachusetts Department of Environmental Protection (MassDEP) Northeast Regional Office in Wilmington, Massachusetts. In addition, copies have been provided to the Somerville Library and the City Clerk's office. A copy of the Report's Executive Summary is attached.

If you have any questions, please contact me at 781-721-4012 or igladstone@geiconsultants.com.

Sincerely,

GEI CONSULTANTS, INC.



Ileen S. Gladstone, P.E., LSP, LEED AP
Vice President

JDR/ISG:csH
Enclosures

c: John R. Badey, UniFirst Corporation
Vithal V. Deshpande, City of Somerville
Andrew Friedmann, MassDEP (as part of Status Report)

Executive Summary

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, GEI Consultants, Inc. (GEI) prepared this Immediate Response Action (IRA) Completion Report Amendment to address issues that the Massachusetts Department of Environmental Protection (MassDEP) raised in a Notice of Audit Findings and Notice of Noncompliance (NOAF/NON) dated February 1, 2011 concerning IRA Completion Report and Remedial Monitoring Report (RMR) No. 11 (IRA Completion Report) submitted for the 50 Tufts Street site (Site) on November 13, 2009.

The Site includes the 50 Tufts Street property (the Property), residential and commercial properties in the neighborhood to the east and west of the Property, and the Michael E. Capuano Early Childhood Center (Capuano Center). Chlorinated volatile organic compounds (VOCs), particularly tetrachloroethylene (also called perchloroethylene [PCE]), have been measured in soil, groundwater, soil vapor, and indoor air at the Site.

The Site has been in Phase IV since August 2009. GEI submitted the Phase II Comprehensive Site Assessment (CSA) and Phase III Evaluation of Remedial Alternatives (Phase II/Phase III) on July 16, 2008. The Phase IV Remedial Implementation Plan (RIP) was submitted on August 10, 2009. As discussed in the Phase II/Phase III and Phase IV RIP, the remedial alternative selected for the Site includes operation of a soil vapor extraction (SVE) system on the Property, implementation and maintenance of Exposure Pathway Elimination Measures (EPEMs) to mitigate complete vapor intrusion pathways, and Monitored Natural Attenuation (MNA) for groundwater. The IRA Completion Report was filed following submittal of the Phase IV RIP, in accordance with the Massachusetts Contingency Plan (MCP; 310 CMR 40.0427).

In the NOAF/NON, MassDEP has announced that it “recommends assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors” for any basement that has at least 7 feet of headroom, without regard to its actual present use. This recommendation is at odds with existing MassDEP risk characterization guidance, and with actual and foreseeable property uses. Nonetheless, with this IRA Completion Report Amendment, GEI also is submitting an Updated Revised Supplemental Method 3 Risk Characterization prepared by ARCADIS U.S., Inc. (ARCADIS). That Report reflects the exposure assumptions that MassDEP requested in its NOAF/NON and data collection and EPEM modification measures completed by GEI as of February 14, 2011. The Updated Revised Supplemental Method 3 Risk Characterization again concludes that a condition of No Significant Risk (NSR) exists for all residential properties except for four residences

(only one of which is listed in the NOAF/NON) for which access to implement EPEMs has been denied.

In the NOAF/NON, MassDEP challenged the adequacy of GEI's determinations in the IRA Completion Report that IRAs were complete with respect to a subset of seven properties.

The NOAF/NON listed four residential properties where, according to MassDEP, mitigation systems were not, but should have been, offered. For each of these properties, as well as other properties with similar characteristics, that were not identified in the NOAF/NON, GEI conducted a property-specific study of the feasibility of eliminating or mitigating the Critical Exposure Pathway (CEP). The results are provided in Sections 3 and 4 of this IRA Completion Report Amendment. Specifically, with respect to the four residential properties identified in the NOAF/NON, EPEMs were either not feasible or not required at these properties because:

- Mitigation systems, in fact, were offered and refused by owners of two properties, 105-107 Washington Street and 111 Washington Street;
- Headroom in the unoccupied basement at one property, 23 Knowlton Street, is less than 7 feet, and chlorinated VOCs have not been detected on the first floor, so there never was an IRA condition; and
- Due to building age, construction details, and poor sub-slab communication, the cost of implementing an EPEM at the fourth property, 6-8 Morton Street, that would further reduce already low concentrations measured in the basement would be prohibitive – many times the \$5,000 estimated cost that MassDEP has said it used as a benchmark for “presumptive feasibility” of sub-slab depressurization systems (SSDSs) for retrofitted CEP mitigation measures.

MassDEP identified three other properties in the NOAF/NON at which EPEMs have been installed that have not entirely eliminated the CEP: 17 Knowlton Street, 27 Tufts Street, and 4 Morton Street. Headroom in the unoccupied basement at 4 Morton is less than 7 feet, and chlorinated VOCs have not been detected on the first floor since the EPEM was installed, so there is no CEP. In addition, the EPEM has been successful in achieving a condition of NSR.

With respect to the remaining two properties, sampling results consistently demonstrate that the EPEMs have been successful both in achieving a condition of NSR and in mitigating CEPs to the extent feasible. That compounds of concern have been mitigated at substantial cost but not completely eliminated is entirely consistent with the MCP (310 CMR 40.0414[3]). The suggestion in the NOAF/NON that “CEPs have not been mitigated to the extent feasible because the option to convert the passive mitigation systems in these homes to active systems has not been attempted” is inconsistent with both Site data and the MCP. The

MCP does not require that a new feasibility evaluation be conducted each time that remedial measures have been implemented without regard to the costs already incurred to implement such measures.

This IRA Completion Report Amendment is being submitted in lieu of an IRA Plan Modification since the CEPs at the properties identified in the NOAF/NON have been eliminated or mitigated to the extent feasible (310 CMR 40.0414[3] and [4]), in conformance with the requirements of the MCP, and operation and maintenance of installed EPEMs are being continued as Comprehensive Response Actions (CRAs). The Phase II/Phase III evaluations have been completed for the Site and a Phase IV RIP is being implemented. The IRA has been closed in accordance with the MCP (310 CMR 40.027). CRAs will continue to be performed as Phase IV activities for the Site (310 CMR 40.029), in accordance with the Phase IV RIP.



Geotechnical
Environmental
Water Resources
Ecological

April 1, 2011
Project 04516-3

Ms. Paulette Renault-Caragianes
Director, Health Department
City Hall Annex
50 Evergreen Avenue
Somerville, MA 02145-2819

Dear Ms. Renault-Caragianes:

**Re: Immediate Response Action Completion Report Amendment
50 Tufts Street
Somerville, Massachusetts
MassDEP RTN 3-23246**

On behalf of UniFirst Corporation (UniFirst) of Wilmington, Massachusetts, and in accordance with the Massachusetts Contingency Plan (MCP; 310 CMR 40.1403[3][c]), GEI Consultants, Inc. is notifying your office that an Immediate Response Action Completion Report Amendment (the Report), dated April 1, 2011, has been prepared for the 50 Tufts Street Site in Somerville, Massachusetts. The Report is available at the Massachusetts Department of Environmental Protection (MassDEP) Northeast Regional Office in Wilmington, Massachusetts. In addition, copies have been provided to the Somerville Library and the City Clerk's office. A copy of the Report's Executive Summary is attached.

If you have any questions, please contact me at 781-721-4012 or igladstone@geiconsultants.com.

Sincerely,

GEI CONSULTANTS, INC.

Ileen S. Gladstone, P.E., LSP, LEED AP
Vice President

JDR/ISG:csh
Enclosures

c: John R. Badey, UniFirst Corporation
Vithal V. Deshpande, City of Somerville
Andrew Friedmann, MassDEP (as part of Status Report)

Executive Summary

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MassDEP RTN 3-23246
Immediate Response Action Completion Report
Amendment
50 Tufts Street, Somerville, Massachusetts
UniFirst Corporation
April 1, 2011

Appendix D

Communication Test Results

RESIDENTIAL PRE-DESIGN INSPECTION FORM

Survey Completed by: L. WELCH / T. DAIGLE Date: 8/2/07 Address: 105-107 WASHINGTON Case #: _____

Part I – Basement Slab Construction

NOTES	
Slab Type: Professional Poured / <u>Owner Poured</u>	
Area: _____ sq. ft.	
Thickness: _____ in.	
Overall Condition: <u>Excellent</u> Good Condition (minor cracks / Poor (fractured)	<u>A few cracks in the skin cant, but otherwise no visible cracks or penetrations</u>
Mitigation Obstructions (utilities, HVAC, etc.):	<u>4 furnaces 3 water heaters</u>
Penetrations:	<u>Sump</u>
Openings/Voids:	<u>none visible</u>

Part II - Sub-slab Soil Characteristics:

NOTES	
Sample 1: ~ front Depth Interval 2 to 6 in.	POSSIBLE VOIDS UNDER SLAB (Porous material) → IN SOME PLACES, VERY LOOSE SAND AND BELOW FOOTINGS
Sample 2: Depth Interval 2 to 6 in. ~ back right	SAND WITH SILT, SOME GRAVEL. WELL COMPACTED / DENSE

23'
Soil Communication Tests

Front		Vacuum Response ("H ₂ O)							
Test A	Applied Vacuum ("H ₂ O)	Monitoring Pt 1 Distance (ft)	Monitoring Pt 2 Distance (ft)	Monitoring Pt 3 Distance (ft)	Monitoring Pt 4 Distance (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
1.	6	0.000	0.000	0.000	0.000				
2.	4.0	-0.004	-0.004 -0.014	-0.009	-0.007				
(max) 3.	34.0 30.0 max	-0.019	-0.069	-0.042	-0.038	(SAND CAPS SPREAD)			
4.									
5.									

Vacuum Response ("H ₂ O)									
Test A	Applied Vacuum ("H ₂ O)	Monitoring Pt 1 Distance (ft)	Monitoring Pt 2 Distance (ft)	Monitoring Pt 3 Distance (ft)	Monitoring Pt 4 Distance (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
6.	0	0.000	0.000						
7.	4.0	0.000	0.000						
8.	30.0	0.000	-0.003						
9.									
10.									

Part III - Foundation Wall Construction:

Above Grade Portion:

		NOTES
Ground Surface to Sill (ft):	2'	
Material Type: Poured Concrete / Stone / Concrete Block / <u>Brick</u>		

Below Grade Portion:

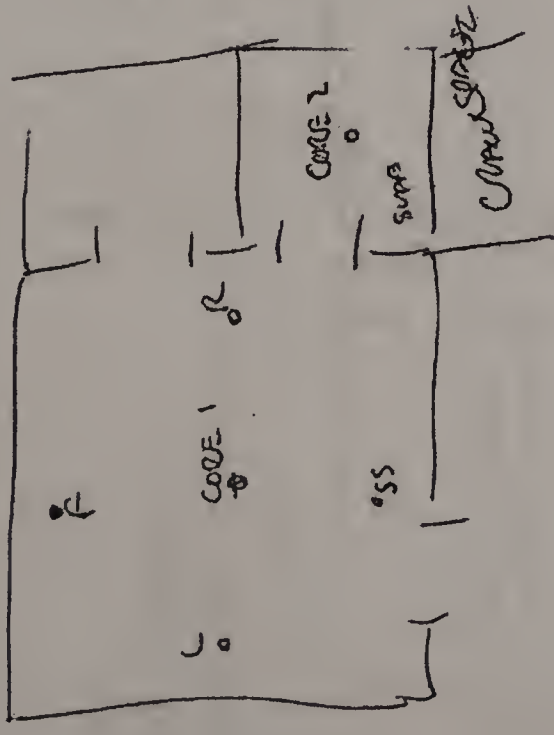
		NOTES
Ground Surface to Slab (ft):	4.5'	
Material Type: Poured Concrete / <u>Stone</u> / Concrete Block / Brick		Paneling finish work near back and concrete below-grade portion
Condition (cracks, holes, pointing, etc.):		Stone covered in skim coat of concrete and paint in many areas near the front. Frontmost storage room has concrete below-grade portion. Adjacent storage room has exposed stone. Some minor holes, but otherwise good condition all around.
Penetrations:		water main
Water Seepage:		none visible
Obstructions:		electrical panels water heaters paneling siding
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.		none
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.		none
Exterior Access:	<input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No	

Part IV – General Observations:

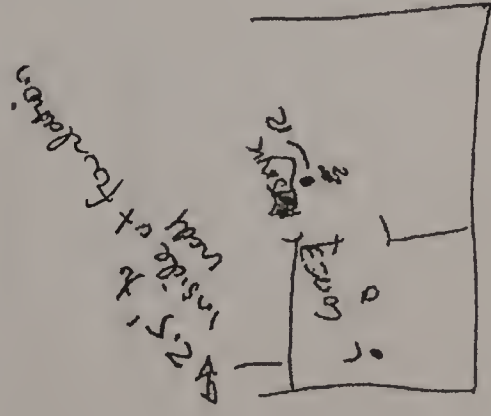
NOTES	
Water Heaters: <u>Gas</u> / Electric / Oil Quantity: <u>4</u>	
Furnaces: <u>Gas</u> / Electric / Oil Quantity: <u>4</u>	
Usage: <u>Laundry</u> / <u>Storage</u> / Living Space	<u>Sewing machines and frequent use, but not necessarily living space</u>
Sumps Present: <u>Yes</u> / No Quantity: <u>1</u> Sump Type: <u>None / Manual / Automatic</u>	
Requirement for Temporary Storage: Sq. Ft. _____	<u>about half of total basement Area (not including crawl space)</u>
Construction Access Issues: (bulkhead, windows, staging/parking areas, etc.)	<u>no bulkhead, narrow stairs</u>

Part V - Basement Foundation Sketch

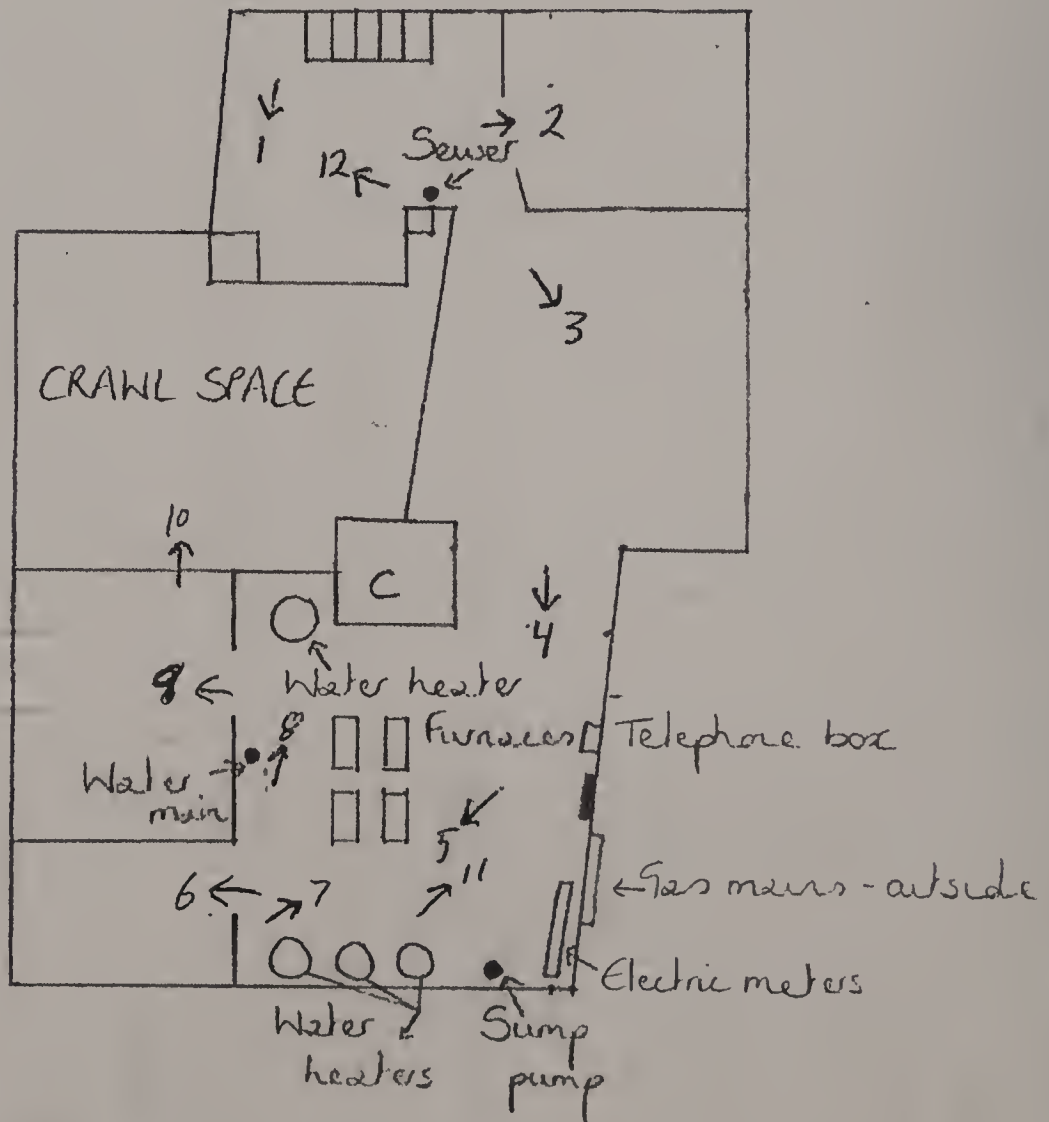
TEST A - FLOOR



TEST B - BRICK



Client Unifirst
 Subject Pre-design basement inspection of
 105-107 Washington St, Somerville, MA



RESIDENTIAL PRE-DESIGN INSPECTION FORM

Survey Completed by: WELCH T. DAUBE Date: 8/9/07 Address: 111 WASHINGTON Case #: _____

Part I – Basement Slab Construction

NOTES	
Slab Type: <u>Professional Poured /</u> <u>Owner Poured</u>	SUBS HAS COMPLETE COVERAGE, INCLUDING CRAWLSPACE. MANY PATCHES FOR PATCHES, ONE DRAIN TRENCH IS RECENT. SOME SURFACE GROOVE CUT (WATER DRAINAGE?). NEW VENTILATION FRONT TO BACK FOR SEWER CONNECTION. SUBS DRAINING SUBS PERIMETER.
Area: _____ sq. ft.	BASEMENT = CRAWLSPACE =
Thickness: <u>2-2.5</u> in.	
Overall Condition: Excellent / <u>Good Condition (minor cracks /</u> <u>Poor Fractured)</u>	OVERALL GOES TO FAIR STRUCTURALLY, WITH CLEANING AND FINING, SUBS MAIN SURFACE SURFACE COPTING. AESTHETICALLY IS POOR, UNIFORM, EXPOSE AGGREGATE.
Mitigation Obstructions (utilities, HVAC, etc.):	NUMEROUS COLUMNS, ONE BRICK CHIMNEY, ONE PARTITION WALL. TOM DAUBE SAYS A PARTITION WAS REMOVED RECENTLY.
Penetrations:	ONE SANITARY DRAIN AT FRONT OF HOUSE, TUBS/DOES BUILT CORNER.
Openings/Voids:	NONE SIGNIFICANT

Part II - Sub-slab Soil Characteristics:

NOTES	
Sample 1: FRONT Depth Interval 2.5 to 5 in. (from top of slab)	TIGHTLY PACKED, SILTY SAND SOIL.
Sample 2: Depth Interval 2 to 5 in. - BACK	SIMILAR TO SAMPLE 1

Soil Communication Tests

LOCATION: FRONT		Pressure							
		Vacuum Response ("H ₂ O)							
Test A	Applied Vacuum ("H ₂ O)	Monitoring Pt 1 Distance (ft)	Monitoring Pt 2 Distance (ft)	Monitoring Pt 3 Distance (ft)	Monitoring Pt 4 Distance (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
1.	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2.	4.0	-0.008	0.000	0.000	0.000	0.000	0.000	0.000	
3.	30.0	-0.059	0.000	0.000	0.000	-0.027	-0.008	-0.007	
4. max. 57.4		-0.070	0.000	0.000	0.000	-0.022	-0.009	-0.008	
5.									

6/11/18
984 4-11

LOCATION: BACK		Pressure							
		Vacuum Response ("H ₂ O), 5L							
Test A	Applied Vacuum ("H ₂ O)	Monitoring Pt 1 Distance (ft)	Monitoring Pt 2 Distance (ft)	Monitoring Pt 3 Distance (ft)	Monitoring Pt 4 Distance (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
6.	0.0	0.000	0.000	0.000	0.000	0.000	0.000		
7.	4.0	0.000	0.000	-0.006	0.000	0.000	-0.021		
8.	30.0	0.000	0.000	-0.035	0.000	0.000	-0.137		
9. max. -36.4		0.000	0.000	-0.042	0.000	0.000	-0.214		
10.									

Part III - Foundation Wall Construction:

Above Grade Portion:

NOTES	
Ground Surface to Sill (ft):	16" SIL TO GROUND, BRICK STONE INTERFACE VORES 1'-3"
Material Type: Poured Concrete / Stone / Concrete Block / <u>Brick</u>	EXPOSED BRICK, PAINTED 80%, PAIR SHAPE, SOME DEGRADATION NEAR WINDOW 2 SMALL WINDOWS AND 1 ABANDONED OPENING BELOW FRONT PORT.

Below Grade Portion:

NOTES	
Ground Surface to Slab (ft): <u>5</u>	
Material Type: Poured Concrete / <u>Stone</u> / Concrete Block / <u>Brick</u>	FIELDSTONE, 213 PAINTED, UNPAINTED IS 1/2 GALL AND 1/2 BACK-LEFT ROUND AND ANGLER STONES
Condition (<u>cracks</u> , holes, pointing, etc.):	SAT SOME OPEN SEAMS BETWEEN MORTAR AND STONES, SOME VOIDS BETWEEN STONES (10%) IN WALLS IN GRANULAR MORE DEEP
Penetrations:	SMALL WATER GAS LINE FRONT WALL, BULKHEAD CRAWLSPACE
Water Seepage:	NONE OBSERVED, COMMON IN SIBS SUGGESTS NEED FOR CAPTURE OR DRAINAGE (NOT DISCUSSED FOR COLLECTION)
Obstructions:	REMANANTS OF DRAINAGE WALLS, DRAIN PIPE AT ANGLE AT FRONT-RIGHT CORNER, GAS METERS IN FRONT WALL, ELECTRICAL PANEL FRONT RIGHT WALL <u>SUPPLY STAND OFF</u>
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.	
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.	
Exterior Access: <u>Yes</u> / No	LIMITED, SMALL STAIRWAY AND BULKHEAD, S/NARROW SIDEWALK

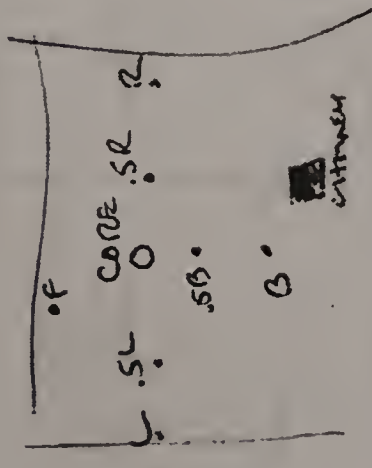
Property address: 111 WASHINGTON

Part IV – General Observations:

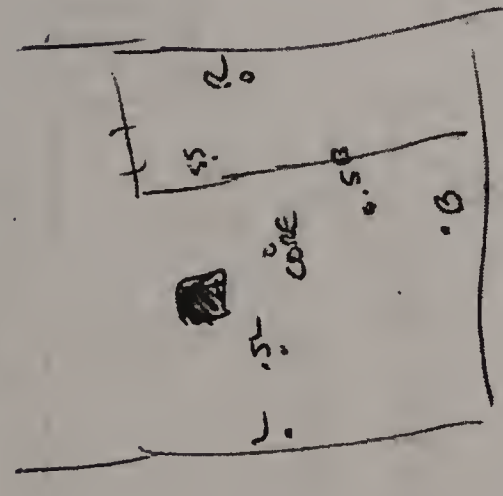
NOTES	
Water Heaters: Gas Electric / Oil Quantity: 2	
Furnaces: Gas Electric / Oil Quantity: 2	
Usage: Laundry / Storage / Living Space	
Sumps Present: Yes / No Quantity: _____ Sump Type: _____ None / Manual / Automatic	
Requirement for Temporary Storage: Sq. Ft. <u>2 100</u>	
Construction Access Issues: (bulkhead, windows, staging/parking areas, etc.)	HAZARDOUS IS PRE-6' WITH OBSTRUCTIONS NARROW STAIRCASE TO LAUNDRY, 90° TURN TO DOOR AT LANDING LOW CLEARANCE BULKHEAD, 3'1/2' W x 4' H, 1'1/2' 1ST STEP UP NARROW SIDEWALK ACCESS TO BULKHEAD. STAIRS BULKHEAD AND RAILING SIDE WALK BULKHEAD DOORS PRESENT / SERVICE OF 105'10" WASHINGTON (ACCESS 2)

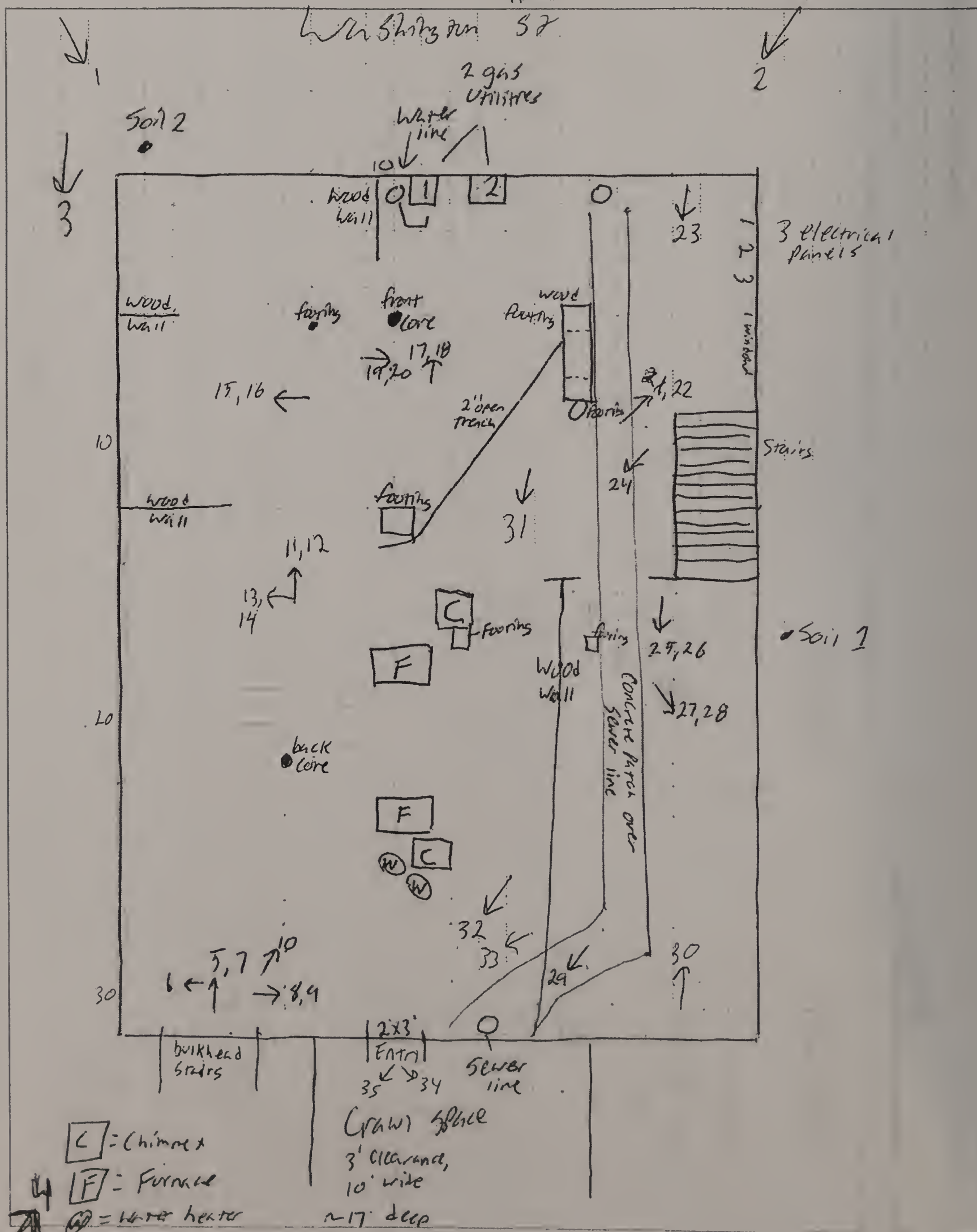
Part V - Basement ^{DETAILS} Foundation Sketch

FLORIT - TEST



ORAC - TEST





RESIDENTIAL PRE-DESIGN INSPECTION FORM

Survey Completed by: NLS, KD Date: 3/7/11 Address: 6-8 Morton St. Case #: _____

Part I – Basement Slab Construction

NOTES	
Slab Type: Professional Poured / <u>Owner Poured</u>	
Area: _____ sq. ft.	
Thickness: _____ in.	
Overall Condition: <u>Excellent / Good Condition (minor cracks / poor (fractured))</u>	Not smooth, pitted, but not a lot of true cracked. Rained right before & there are areas of water & dampness
Mitigation Obstructions (utilities, HVAC, etc.):	sewer, water, gas pipes 3 furnaces, 3 HW heaters, 3 laundry machines, built partitions
Penetrations: <u>2 by elec panel, typical</u>	Base of stairs has lot of sewer pipes - no joists to drill thru
Openings/Voids:	

Property address: _____

Part II – Sub-slab Soil Characteristics:

NOTES	
Sample 1: Depth Interval <u>0</u> to <u>6</u> in.	<u>04S163-6-8 MAX-50</u> <u>sub-slab sample</u>
Sample 2: Depth Interval _____ to _____ in.	

Soil Communication Tests

forward board front ignited (quartz)

2: 6-8 in.

Test A	Applied Vacuum ("H ₂ O)	Vacuum Response ("H ₂ O)							
		Monitoring Pt 1 Distance 6 (ft)	Monitoring Pt 2 Distance 5 (ft)	Monitoring Pt 3 Distance 20 (ft)	Monitoring Pt 4 Distance 23 (ft)	Monitoring Pt 5 Distance 10 (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
1.	<u>0</u>		<u>0.000</u>	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>			
2.	<u>2</u>	<u>0.22</u>	<u>-0.000</u>	<u>0.000</u>	<u>0.000</u>	<u>-0.03</u>			
3.	<u>4</u>	<u>-0.92</u>	<u>-0.006</u>	<u>-0.007</u>	<u>-0.13</u>				
4.	<u>6</u>	<u>-1.4</u>	<u>-0.012</u>	<u>-0.012</u>	<u>-0.18</u>				
5.	<u>max</u>	<u>-2.95</u>	<u>-0.035</u>	<u>-0.023</u>	<u>-0.40</u>				

0.56-5.6

Test A	Applied Vacuum ("H ₂ O)	Vacuum Response ("H ₂ O)							
		Monitoring Pt 1 Distance (ft)	Monitoring Pt 2 Distance (ft)	Monitoring Pt 3 Distance (ft)	Monitoring Pt 4 Distance (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)
6.									
7.									
8.									
9.									
10.									

Part III - Foundation Wall Construction:

Above Grade Portion:

NOTES	
Ground Surface to Sill (ft):	~ 15"
Material Type: Poured Concrete / Stone Concrete Block / Brick	field stone foundation w/ brick skirt

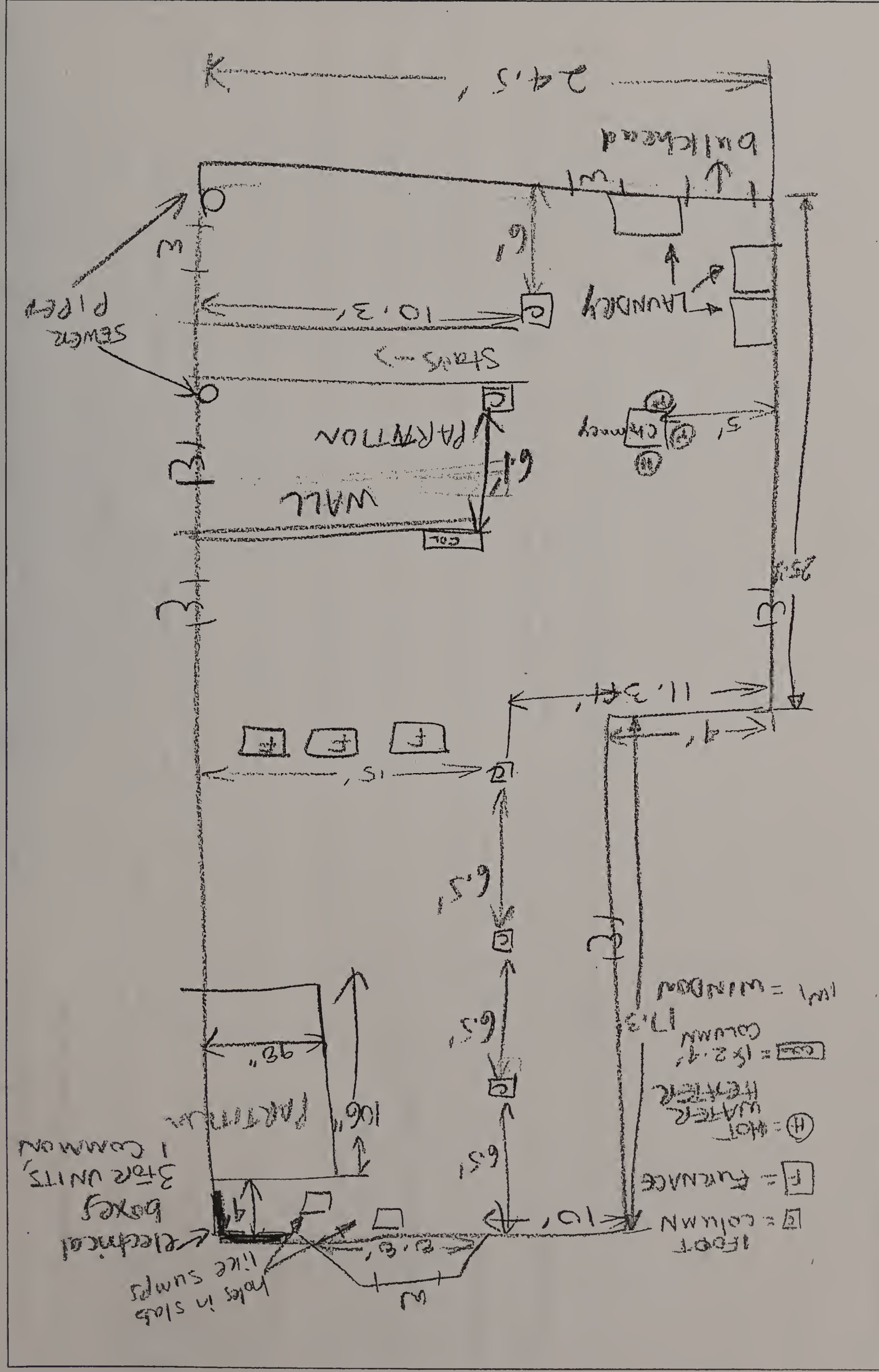
Below Grade Portion:

NOTES	
Ground Surface to Slab (ft):	to joist front by sump 7.2' back by laundry 7.1'
Material Type: Poured Concrete / <u>Stone</u> / <u>Brick</u>	
Condition (cracks, holes, pointing, etc.):	pointing dx. looks like fairly fresh patches front of house
Penetrations:	electric pendants, sewer near back head
Water Seepage:	not on walls just floor
Obstructions:	built walls, etc/gas
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____	see previous page
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____	
Exterior Access: <u>Yes</u> / No	

Property address: 6-8 Morton

Part IV – General Observations:

	PROPERTY NOTES
Water Heaters: (Gas / Electric / Oil) Quantity: <u>2</u>	age looks like 1 pretty new (<5 yr), 1 5-10 yr, 1 >10 yr
Furnaces: (Gas / Electric / Oil) Quantity: <u>2</u>	look same age, <10 yrs
Usage: (Laundry / Storage / Living Space)	
Sumps Present: Yes / No Quantity: _____ Sump Type: _____ None / Manual / Automatic	2 holes that look like sump
Requirement for Temporary Storage: Sq. Ft. _____	
Construction Access Issues: (bulkhead, windows, staging/parking areas, etc.)	Small human door w/ tight turn to access basement, half-door (not full height) or bulk head



RESIDENTIAL PRE-DESIGN INSPECTION FORM

Survey Completed by: T. Daigle Date: 9-12-08 Address: 17 Knowlton St Case #: _____

Part I – Basement Slab Construction

NOTES	
Slab Type: Professional Poured / <u>Owner Poured</u>	Aggregate Showing over much of slab. few cracks and thin areas throughout, two openings near front wall ~ 2' x 2' top.
Area: _____ sq. ft.	
Thickness: <u>1-2</u> in.	
Overall Condition: Excellent / Good Condition (minor cracks / <u>Poor (fractured)</u>)	
Mitigation Obstructions (utilities, HVAC, etc.):	
Penetrations:	Water meter
Openings/Voids:	2 moderate openings near front wall. 1 for water utility ~ 2' x 3' the 1 just open space ~ 5' x 4'

Part II - Sub-slab Soil Characteristics:

		NOTES
Sample 1: Depth Interval <u>2</u> to <u>4</u> in.		Sandy silt. fine to medium sand, minor silt. loose, dry.
Sample 2: Depth Interval <u>4</u> to <u>6</u> in.		Silt+y sand. tight, mostly silt, damp Singular Sub-slab Soil Characteristics in front core (Back)

Sandy silt below slab, and silty/tight a few inches down.

Soil Communication Tests

Back Core

Test A	Applied Vacuum ("H ₂ O)	Vacuum Response ("H ₂ O)					Monitoring Pt		
		Monitoring Pt 1 Distance <u>11</u> (ft)	Monitoring Pt 2 Distance <u>5</u> (ft)	Monitoring Pt 3 Distance <u>5</u> (ft)	Monitoring Pt 4 Distance <u>10</u> (ft)	Monitoring Pt 5 Distance <u>4</u> (ft)	Monitoring Pt 6 Distance <u>5</u> (ft)	Monitoring Pt 7 Distance <u>9.5</u> (ft)	Monitoring Pt 8 Distance (ft)
1.	0								
2.	1.9"	0	-0.003	-0.005	0	0	0	0	
3.	4.0"	0	-0.004	-0.013	-0.003	0	0	0	
4.	8.0"	0	-0.006	-0.023	0	0	0	0	
5.	12.0"	0	-0.006	-0.021	0	0	0	0	

(max)

Front Core

Test A	Applied Vacuum ("H ₂ O)	Vacuum Response ("H ₂ O)					Monitoring Pt		
		Monitoring Pt 8 Distance <u>4</u> (ft)	Monitoring Pt 9 Distance <u>4</u> (ft)	Monitoring Pt 10 Distance <u>8</u> (ft)	Monitoring Pt 11 Distance <u>5</u> (ft)	Monitoring Pt 12 Distance <u>9</u> (ft)	Monitoring Pt 13 Distance <u>4</u> (ft)	Monitoring Pt 2 Distance <u>12</u> (ft)	Monitoring Pt 8 Distance (ft)
6.	0								
7.	1.9"	0	0	0	0	0	-0.011 -0.010	0	
8.	4.0"	0	-0.004	0	0	0	-0.020	0	
9.	8.0"	-0.006	-0.009	0	-0.006	0	-0.039	-0.003	
10.	15.0"	-0.009	-0.017	0	-0.009	0	-0.063	-0.003	

Part III - Foundation Wall Construction:

Above Grade Portion:

	NOTES
Ground Surface to Sill (ft): 2 ft	2
Material Type: Poured Concrete / Stone / Concrete Block / Brick	

Below Grade Portion:

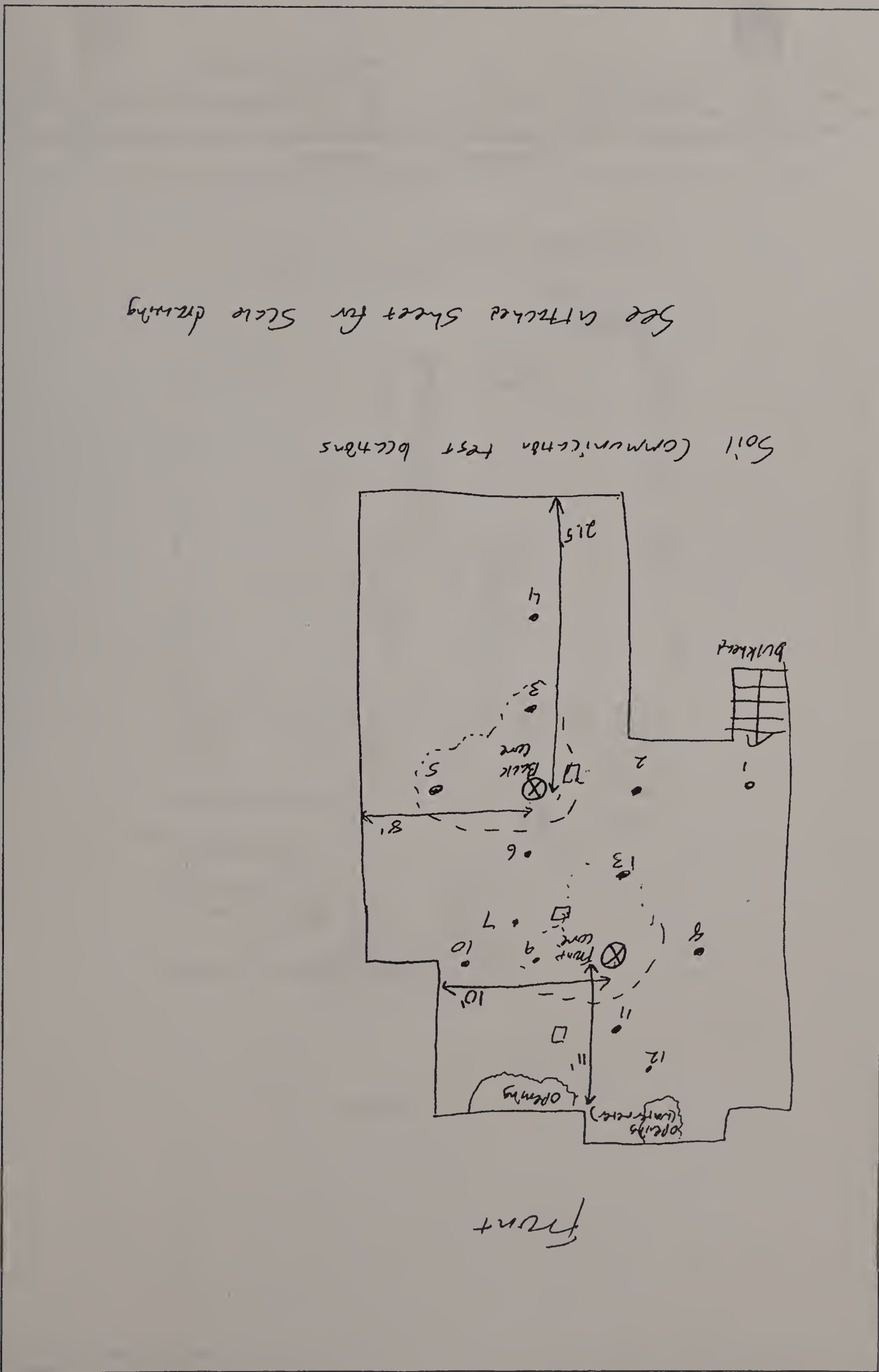
	NOTES
Ground Surface to Slab (ft): 5	
Material Type: Poured Concrete / Stone / Concrete Block / Brick	
Condition (cracks, holes, pointing, etc.):	Painted all around, few cracks, no major cracks or holes
Penetrations:	gas main
Water Seepage:	none visible
Obstructions:	Shelving (wood), water heaters, sewer pipes in back corner -
Backfill Sample 1 Depth Interval: _____ to _____ ft Distance to Wall: _____ ft.	
Backfill Sample 1 Depth Interval: _____ to _____ ft Distance to Wall: _____ ft.	
Exterior Access: <input checked="" type="checkbox"/> Yes / No	bulkhead

Property address: 17 Knorr Lane

Part IV – General Observations:

NOTES	
Water Heaters: Gas / Electric / Oil Quantity: <u>2</u>	
Furnaces: Gas / Electric / Oil Quantity: <u>2</u>	One set on 8" cmv but older than 5 yr One set on 2" cmv
Usage: Laundry / Storage / Living Space	
Sumps Present: Yes / No Quantity: _____ Sump Type: _____ None / Manual / Automatic	
Requirement for Temporary Storage: Sq. Ft. <u>~200</u>	washer, dryer, fridge, storage items, desk
Construction Access Issues: (bulkhead) windows, staging/parking areas, etc.)	

Part V – Basement Foundation Sketch





Client

Uni First

Subject

Subject Scale Drawing 17 Knowlton St
Basement

Project 045163

By T. Daigle

Checked

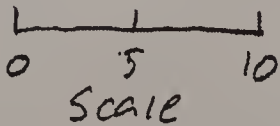
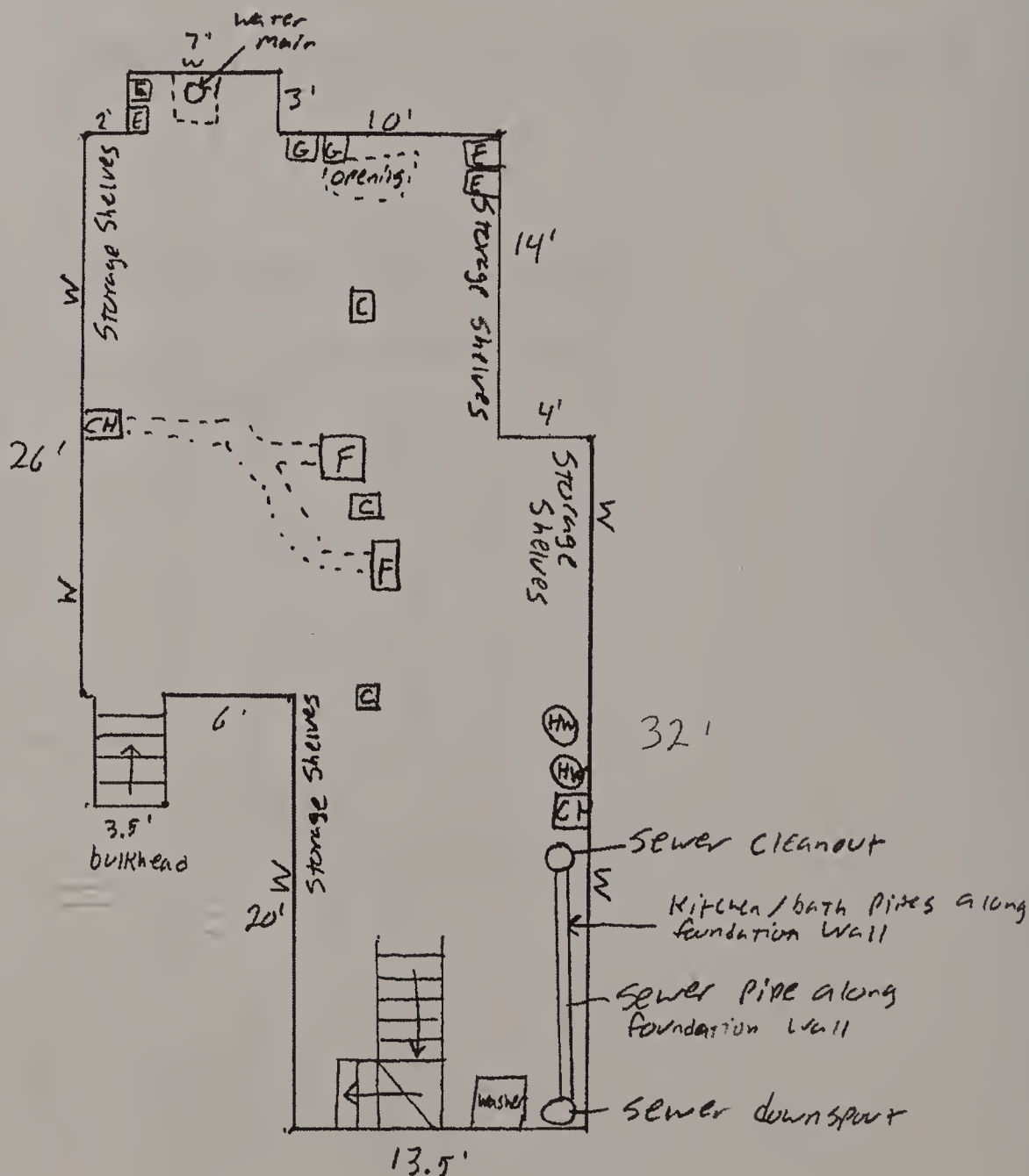
Approved

Page 1 of 1

Date 9-12-08

Date _____

Date _____



1 Square = 2 ft

Client Um' First

By Steve Chernicky

Date 9-12-08

Subject Photo Log 17 Knowlton St
Basement

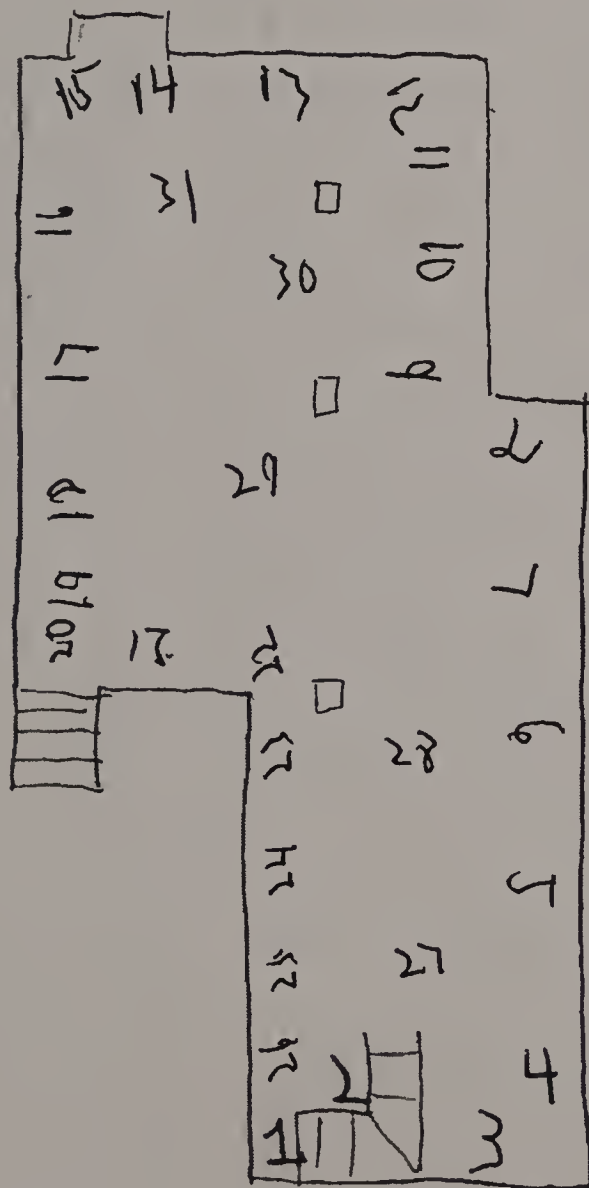
Checked

Date

Approved

Date

Knowlton Street



RESIDENTIAL PRE-DESIGN INSPECTION FORM

Survey Completed by: T. Daigle Date: 11-8-07 Address: 162-164 6/era st Case #: _____

Part I – Basement Slab Construction

		NOTES
Slab Type: Professional Poured / Owner Poured		<u>Owner</u>
Area: _____ sq. ft.		
Thickness: <u>2-3</u> in.		<u>Slightly uneven surface</u>
Overall Condition: Excellent / Good Condition (minor cracks / Poor (fractured)		<u>Good Condition. Uneven surface. some patches</u>
Mitigation Obstructions (utilities, HVAC, etc.):		<u>gas utilities, water main, electrical panels all in front, elevated plywood floor near middle</u> <u>2 washers, 2 doors, 3 furnaces, 3 washer heaters, paneling on north and west walls</u> <u>water main, sewer main</u>
Penetrations:		
Openings/Voids:		<u>None visible</u>

617-628-1395
617-628-2145 - Johanna

Property address: 162-164 Glen

Part II - Sub-slab Soil Characteristics:

Front Core		NOTES	
Sample 1:	Depth Interval <u> </u> to <u> </u> in.	Sandy soil with minor gravel and silt, not quite as sandy as Back Core.	
Back Core	Depth Interval <u>2</u> to <u>4</u> in.	Core not intact, but slab has good-moderate integrity. 3" slab thickness	
Sample 2:	Depth Interval <u>2</u> to <u>4</u> in.	Sandy soil with minor silt, like black sand.	
		Core not intact, but good-moderate slab integrity. 3" slab thickness	

Soil Communication Tests

Front Core

Test A	Applied Vacuum ("H ₂ O)	Front					Middle					Back				
		Monitoring Pt 1 Distance 10 (ft)	Monitoring Pt 2 Distance 12 (ft)	Monitoring Pt 3 Distance 10 (ft)	Monitoring Pt 4 Distance 12 (ft)	Monitoring Pt 5 Distance (ft)	Monitoring Pt 6 Distance (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)	Monitoring Pt 9 Distance (ft)	Monitoring Pt 10 Distance (ft)	Monitoring Pt 11 Distance (ft)	Monitoring Pt 12 Distance (ft)	Monitoring Pt 13 Distance (ft)	Monitoring Pt 14 Distance (ft)	Monitoring Pt 15 Distance (ft)
1.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	1.8"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.	4.0"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	30.0"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.	42"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

40 max

front left 500-5100

Test A	Applied Vacuum ("H ₂ O)	Back					Middle					Front				
		Monitoring Pt 1 Distance 6.5 (ft)	Monitoring Pt 2 Distance 9 (ft)	Monitoring Pt 3 Distance 9 (ft)	Monitoring Pt 4 Distance 7.5 (ft)	Monitoring Pt 5 Distance 220 (ft)	Monitoring Pt 6 Distance 12.5 (ft)	Monitoring Pt 7 Distance (ft)	Monitoring Pt 8 Distance (ft)	Monitoring Pt 9 Distance (ft)	Monitoring Pt 10 Distance (ft)	Monitoring Pt 11 Distance (ft)	Monitoring Pt 12 Distance (ft)	Monitoring Pt 13 Distance (ft)	Monitoring Pt 14 Distance (ft)	Monitoring Pt 15 Distance (ft)
6.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	1.8"	-0.055	-0.023	-0.043	-0.015	0	-0.006	0	0	0	0	0	0	0	0	0
8.	4.0"	-0.104	-0.042	-0.088	-0.029	0	-0.012	0	0	0	0	0	0	0	0	0
9.	30.0"	-0.935	-0.345	-0.878	-0.232	0	-0.106	0	0	0	0	0	0	0	0	0
10.	39.5" ± max															

Part III - Foundation Wall Construction:

Above Grade Portion:

	NOTES
Ground Surface to Sill (ft):	<u>2.5 2.5 feet</u>
Material Type: Poured Concrete / Stone / Concrete Block / <u>Brick</u>	<u>Good condition. Minor holes</u>

Below Grade Portion:

	NOTES
Ground Surface to Slab (ft):	<u>5 ft</u>
Material Type: Poured Concrete / <u>Stone</u> / Concrete Block / Brick	
Condition (cracks, holes, pointing, etc.):	<u>Moderate to good condition cracks + holes filled, but some of the fill is eroding out. Set Stone foundation is 5' off slab on south wall, stepping to 4' on north wall.</u>
Penetrations:	<u>1.5" pipe stub near lower main</u>
Water Seepage:	<u>none visible</u>
Obstructions:	<u>furnaces, numerous dividing walls, water heaters, plywood floor covering</u>
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.	<u>None taken</u>
Backfill Sample 1 Depth Interval: _____ to _____ ft. Distance to Wall: _____ ft.	<u>None taken</u>
Exterior Access: <u>Yes</u> / No	<u>Thru bulkhead or window stairs</u>

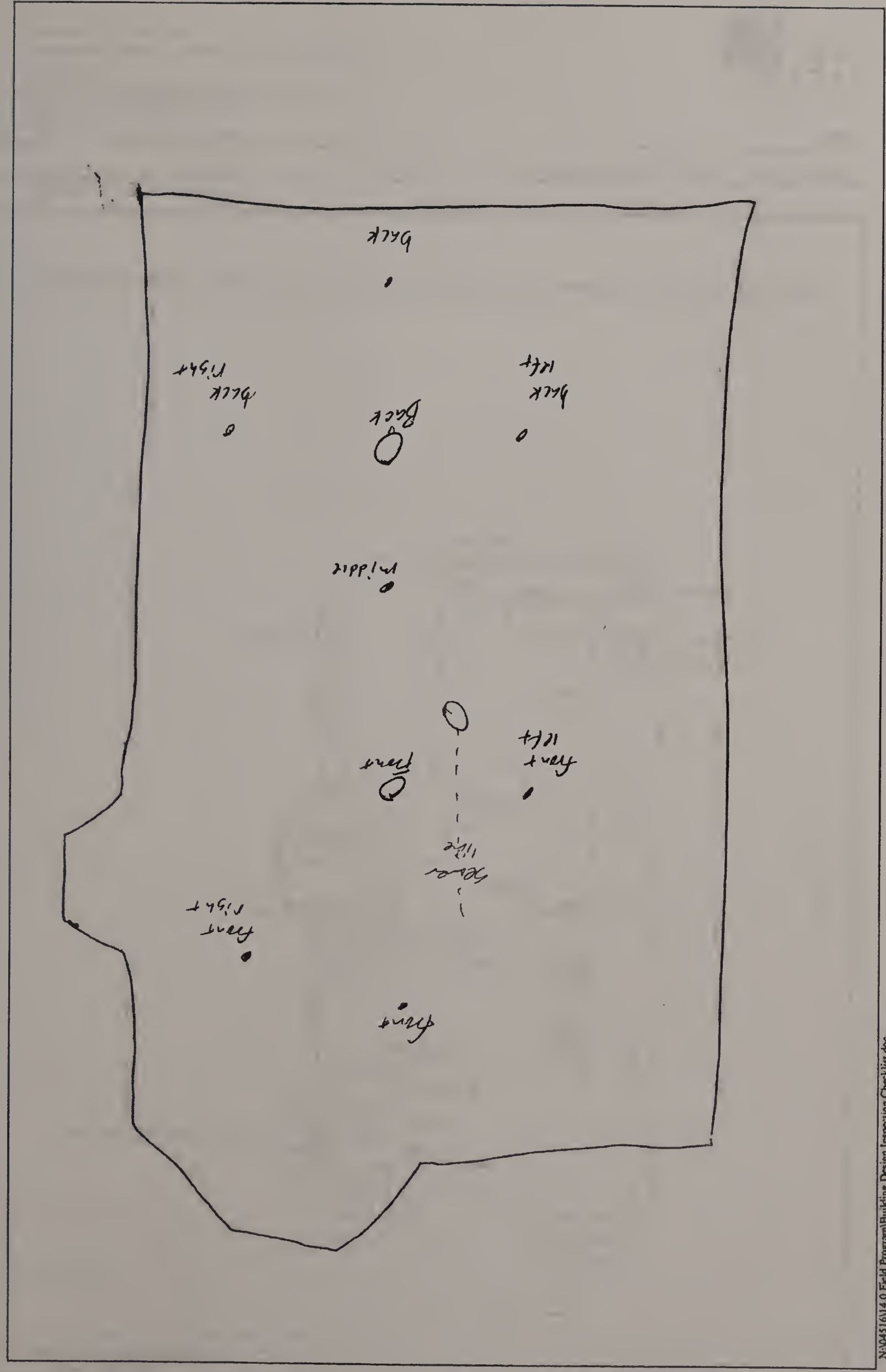
Property address: 162-164 Glen

Part IV – General Observations:

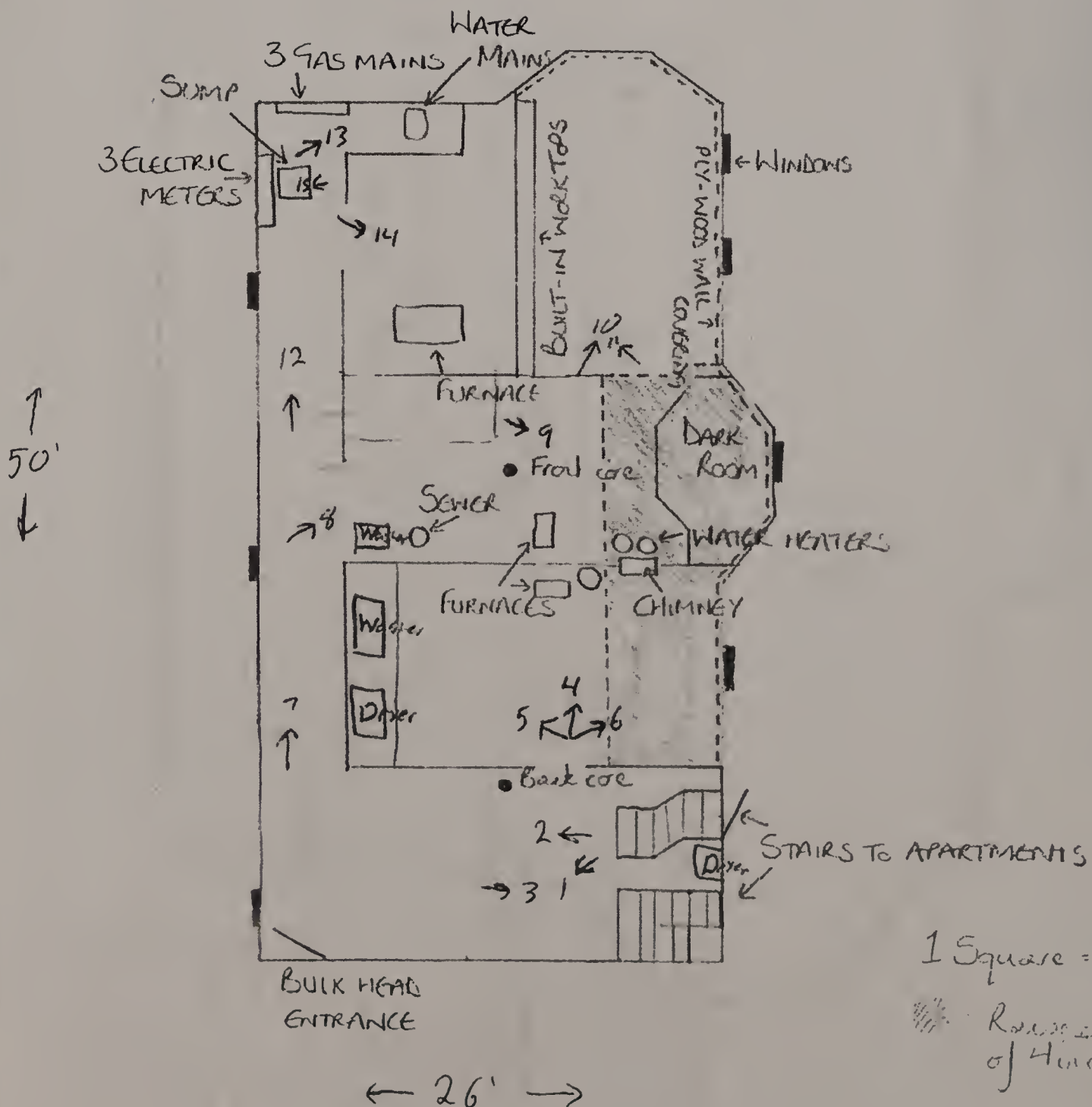
NOTES	
Water Heaters: Gas / Electric / Oil Quantity: 3	All new Center
Furnaces: Gas / Electric / Oil Quantity: 3	All new Center
Usage: Laundry Storage / Living Space	
Sumps Present: Yes / No Quantity: 1 Sump Type: None / Manual / Automatic	Sump hole and Sewer Cleanout? NEXT to electric + gas meters in front left.
Requirement for Temporary Storage: Sq. Ft. _____	~ 1/3 of total area
Construction Access Issues: (bulkhead, windows, staging/parking areas, etc.)	None

Property address: 162-1661

Part V – Basement Foundation Sketch



Client
 Subject 162-164 Glen Street



Appendix E

Property Inspection Log Documenting Basement Ceiling Height

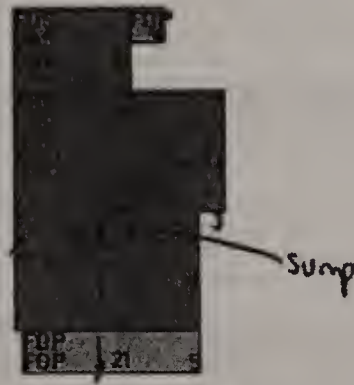
SUB-SLAB MONITORING POINT INSTALLATION LOG



Project Name: **Tufts Street**
Project Number: **045162**
Address: **23 Knowlton Street**
Date: **2/28/2007**
Logged by: **K. Wolfe**

Sub-Slab Monitoring Point IDs:
SS1

Basement Sketch



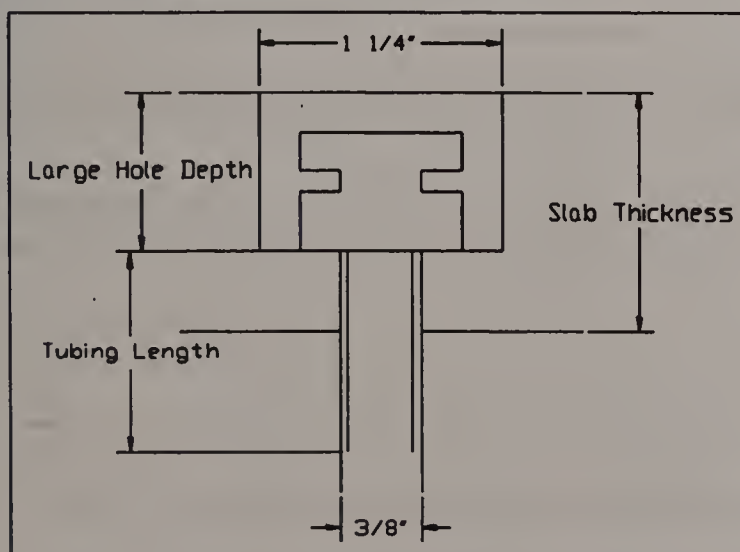
Ceiling Height: **6'9"**

Basement Height Above
Grade: **2'7"**

Include: Wall lengths, sump dimension and location, dimensions and locations of any significant penetrations in the ground, sub-slab monitoring point locations, location of sealed vs. non-sealed walls, north arrow

Basement Sketch for Photo Log:

Sub-Slab Monitoring Point Profile



	SS1	SS2	SS3	SS4
Slab Thickness:	4-5'			
Tubing Length:	2"			
Type of Material Under Slab:	silt			
Large Hole Depth:	2"			

Comments:

EPEM Options 2 3 Monthly Monitoring Form

GENERAL MONITORING INFORMATION FOR PASSIVE EPEM SYSTEMS

GEI Field Representative(s): <u>S. Slater</u> Date: <u>02/26/11</u> Weather: <u>Partly cloudy, 30°</u>	Property: <u>17 Knowlton Street</u> Monitoring Start Time: <u>9:45 AM</u> Monitoring End Time: <u>10:05 AM</u> Option 2 or 3?: <u>Option 3</u>
-------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

INSTRUMENTATION INFORMATION

Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000	07-01059	100 ppm Isobutylene Time: 09:30	Y / N Cal. Reading (ppm): 102

FIELD MEASUREMENTS / OBSERVATIONS

System Status/Configuration

Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Interior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Epoxy Condition (cracks, peeling, water damage, etc.)?	good / fair / poor
Slab or Wall Cracks / Openings That Impair System Performance?	Y / N
Downdraft Prevention Cap Present?	Y / N

NOTES

1. EPEM = Exposure Pathway Elimination Measure.
2. Option 2 = Consists of a venting system installed in a shallow trench around the interior basement floor perimeter, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
4. Option 3 = Consists of a venting system installed beneath the basement floor, a new concrete floor slab, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
5. ppm = parts per million.
6. PID = photoionization detector.
7. VOC = volatile organic compound.

COMMENTS

1. Measured ceiling height to joist in front of basement: 79 inches.
2. Measured ceiling height to joist in back of basement: 80 inches.

Reviewed by: _____

EPEM Options 2 3 Monthly Monitoring Form

GENERAL MONITORING INFORMATION FOR PASSIVE EPEM SYSTEMS

GEI Field Representative(s): <u>B. Simons</u> Date: <u>03/23/11</u> Weather: <u>Cloudy, 30's</u>	Property: <u>4 Morton Street</u> Monitoring Start Time: <u>2:00 PM</u> Monitoring End Time: <u>2:30 PM</u> Option 2 or 3?: <u>Option 3</u>
-----------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

INSTRUMENTATION INFORMATION

Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000	07-01059	Not applicable	Y / N Cal. Reading (ppm):

FIELD MEASUREMENTS / OBSERVATIONS

System Status/Configuration

Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Interior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Epoxy Condition (cracks, peeling, water damage, etc.)?	good / fair / poor
Slab or Wall Cracks / Openings That Impair System Performance?	Y / N
Downdraft Prevention Cap Present?	Y / N

NOTES

1. EPEM = Exposure Pathway Elimination Measure
2. Option 2 = Consists of a venting system installed in a shallow trench around the interior basement floor perimeter, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
4. Option 3 = Consists of a venting system installed beneath the basement floor, a new concrete floor slab, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
5. ppm = parts per million
6. PID = photoionization detector
7. VOC = volatile organic compound

COMMENTS

1. Measured ceiling height to joist in front of basement: 77 inches.
2. Measured ceiling height to joist in back of basement: 76 inches.

Reviewed by: _____

EPEM Options 2 3 **Monthly Monitoring Form**

GENERAL MONITORING INFORMATION FOR PASSIVE EPEM SYSTEMS

GEI Field Representative(s):	<u>S. Slater</u>	Property:	<u>27 Tufts Street</u>
		Monitoring Start Time:	<u>10:00 AM</u>
Date:	<u>02/23/11</u>	Monitoring End Time:	<u>10:30 AM</u>
Weather:	<u>Sunny, 30°</u>	Option 2 or 3?:	<u>Option 3</u>

INSTRUMENTATION INFORMATION

Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000	07-01059	100 ppm Isobutylene Time: 09:45	Y / N Cal. Reading (ppm): 102

FIELD MEASUREMENTS / OBSERVATIONS

System Status/Configuration

Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Interior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Epoxy Condition (cracks, peeling, water damage, etc.)?	good / fair / poor
Slab or Wall Cracks / Openings That Impair System Performance?	Y / N
Downdraft Prevention Cap Present?	Y / N

NOTES

- EPEM = Exposure Pathway Elimination Measure
- Option 2 = Consists of a venting system installed in a shallow trench around the interior basement floor perimeter, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
- Option 3 = Consists of a venting system installed beneath the basement floor, a new concrete floor slab, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
- ppm = parts per million
- PID = photoionization detector
- VOC = volatile organic compound

COMMENTS

- Applied EPEM sticker.
- Measured ceiling height to joist in basement: 80 inches.

Reviewed by: _____

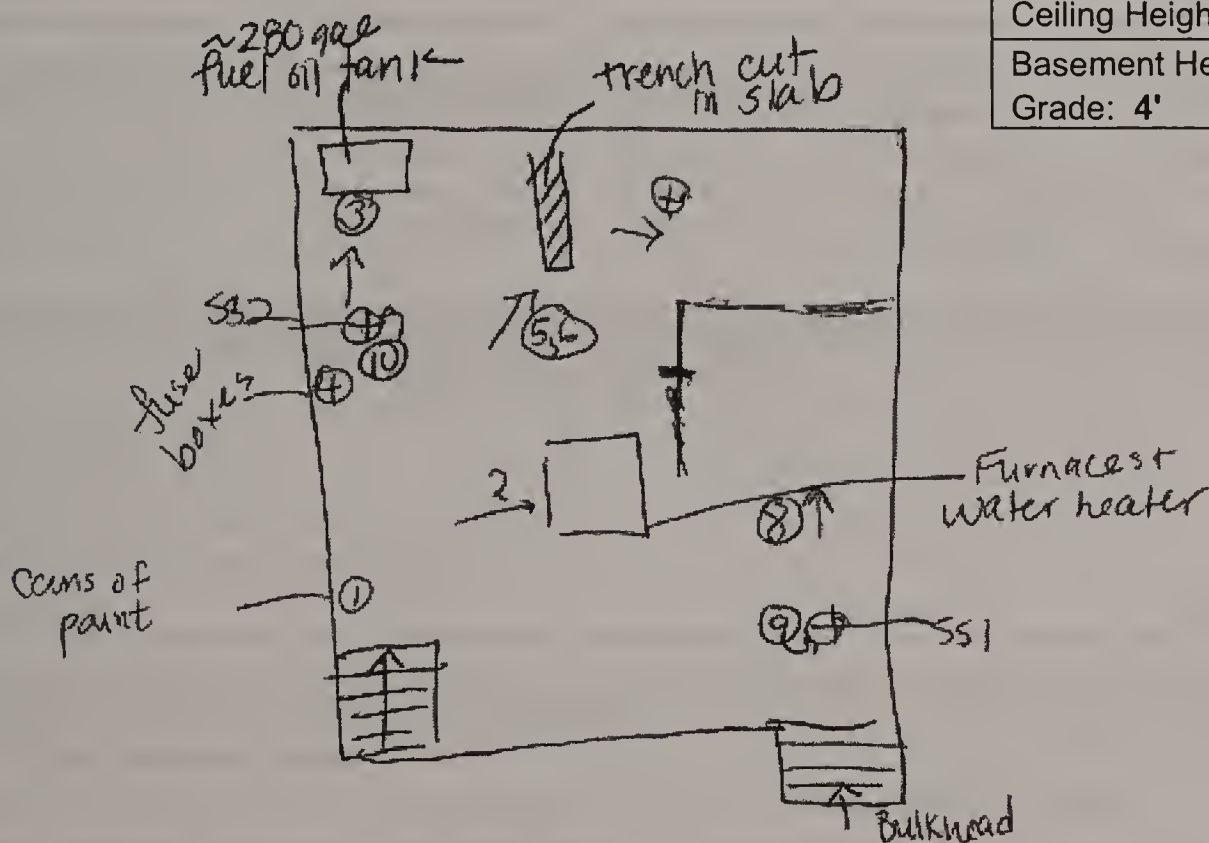
SUB-SLAB MONITORING POINT INSTALLATION LOG



Project Name: Tufts Street
 Project Number: 045162
 Address: 99 Franklin Street
 Date: 5/8/2007
 Logged by: H. Ballantyne S. Slater

Sub-Slab Monitoring Point IDs:
 SS1 and SS2

Basement Sketch / Basement Sketch for Photo Log:

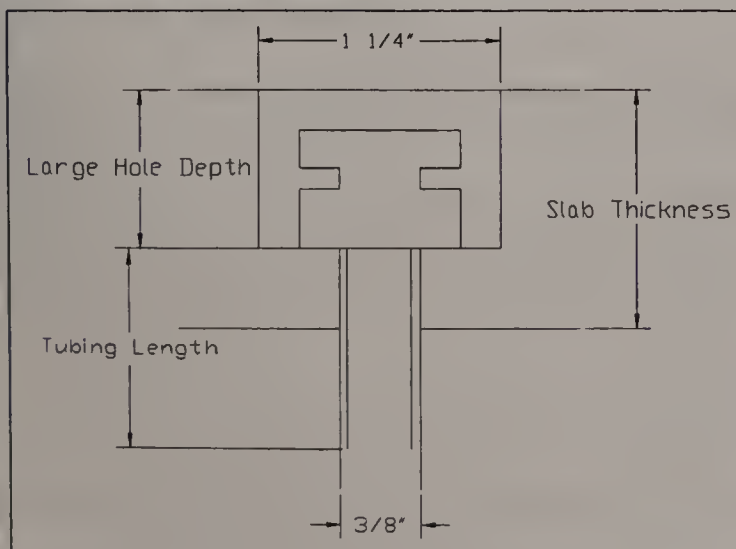


Ceiling Height: 6.5'

Basement Height Above Grade: 4'

Include: Wall lengths, sump dimension and location, dimensions and locations of any significant penetrations in the ground, sub-slab monitoring point locations, location of sealed vs. non-sealed walls, north arrow

Sub-Slab Monitoring Point Profile



	SS1	SS2	SS3	SS4
Slab Thickness:	4"	3.25"		
Tubing Length:	1.5"	1"		
Type of Material Under Slab:	fill	sand/silt		
Large Hole Depth:	3"	2"		

Comments: SS1 depth to wet soil 6.5" from top of slab.

**EPEM Options 2 3
Monthly Monitoring Form**

GENERAL MONITORING INFORMATION FOR PASSIVE EPEM SYSTEMS

GEI Field Representative(s): S. Slater, N. Slagowski

Date: 03/04/11

Weather: Partly cloudy, 25°

Property: 10 Morton Street

Monitoring Start Time: 9:15 AM

Monitoring End Time: 9:25 AM

Option 2 or 3?: Option 3

INSTRUMENTATION INFORMATION

Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000	07-01059	100 ppm Isobutylene Time: 07:55	Y / N Cal. Reading (ppm): 100

FIELD MEASUREMENTS / OBSERVATIONS

System Status/Configuration

Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Interior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Epoxy Condition (cracks, peeling, water damage, etc.)?	good / fair / poor
Slab or Wall Cracks / Openings That Impair System Performance?	Y / N
Downdraft Prevention Cap Present?	Y / N Whirling kind

NOTES

1. EPEM = Exposure Pathway Elimination Measure.
2. Option 2 = Consists of a venting system installed in a shallow trench around the interior basement floor perimeter, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
4. Option 3 = Consists of a venting system installed beneath the basement floor, a new concrete floor slab, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
5. ppm = parts per million.
6. PID = photoionization detector.
7. VOC = volatile organic compound.

COMMENTS

1. Epoxy to sill in this EPEM.
2. Epoxy has signs of water around bulkhead for about a 10 foot radius.
3. Measured ceiling height to joist in front of basement: 77 inches.
4. Measured ceiling height to joist in front of basement: 75.5 inches.

Reviewed by: _____

EPEM Options 2 3 Monthly Monitoring Form

GENERAL MONITORING INFORMATION FOR PASSIVE EPEM SYSTEMS

GEI Field Representative(s): <u>S. Slater</u> Date: <u>03/10/11</u> Weather: <u>Overcast, 39°</u>	Property: <u>95 Franklin Street</u> Monitoring Start Time: <u>8:25 AM</u> Monitoring End Time: <u>8:40 AM</u> Option 2 or 3?: <u>Option 2</u>
--------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

INSTRUMENTATION INFORMATION

Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000	07-01059	100 ppm Isobutylene Time: 08:15	Y / N Cal. Reading (ppm): 102

FIELD MEASUREMENTS / OBSERVATIONS

System Status/Configuration

Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Interior Pipe Condition (cracks, damage, etc.)?	good / fair / poor
Epoxy Condition (cracks, peeling, water damage, etc.)?	good / fair / poor
Slab or Wall Cracks / Openings That Impair System Performance?	Y / N
Downdraft Prevention Cap Present?	Y / N

NOTES

1. EPEM = Exposure Pathway Elimination Measure
2. Option 2 = Consists of a venting system installed in a shallow trench around the interior basement floor perimeter, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
4. Option 3 = Consists of a venting system installed beneath the basement floor, a new concrete floor slab, cement stucco applied to the walls, and an epoxy vapor barrier applied to the walls and floor.
5. ppm = parts per million
6. PID = photoionization detector
7. VOC = volatile organic compound

COMMENTS

1. Measured ceiling height to joist in front of basement: 65 inches.
2. Measured ceiling height to joist in back of basement: 64 inches.

Reviewed by: _____

EPEM Option 1 Inspection Form

GENERAL MONITORING INFORMATION			
GEI Field Representative(s):	S. Slater	Address:	18 Morton Street
		Monitoring Start Time:	6:00 PM
Date:	2/25/2011	Monitoring End Time:	6:10 PM
Weather:	Mostly Cloudy, 40°		

INSTRUMENTATION INFORMATION					
Instrument	Manufacturer	Model	Serial No.	Calibrated To:	Successful Calibration?
PID (ppm)	ION Science L.L.C.	PhoCheck 5000		100 ppm Isobutylene Time: 17:45	Y / N Cal. Reading (ppm): 101
Manometer (in. H ₂ O)	Dwyer	Mark 111-475-0 Series		N/A	Zeroed before each reading? Y / N

FIELD MEASUREMENTS / OBSERVATIONS					
System Status/Configuration		Pressure/VOC Measurements			
		Monitoring Point	Pressure (in. H ₂ O)	VOC (ppm)	Location Description (e.g., distance from foundation walls)
Radon Fan On?	Y / N	SS1	-0.275	NM	
Exterior Fan Condition (housing, wires, etc)?	good / fair / poor	SS2	-0.012	NM	
Excessive fan noise?	Y / N	permanent manometer	-2.4	NM	measured -2.407 with hand-held manometer
Interior Extrecton Pipe Condition (cracks, damage, etc)?	good / fair / poor				
Exterior Pipe Condition (cracks, damage, etc.)?	good / fair / poor				
Leaks Around Slab Penetrations?	Y / N				
Slab or Well Cracks / Openings That Impair System Performance?	Y / N				

NOTES:
ppm = parts per million PID = photoionization detector N/A = Not Applicable VOC = volatile organic compound in. H ₂ O = Inches of water column

COMMENTS:

The owner had dug a sump along the north wall in the front central portion of the basement.

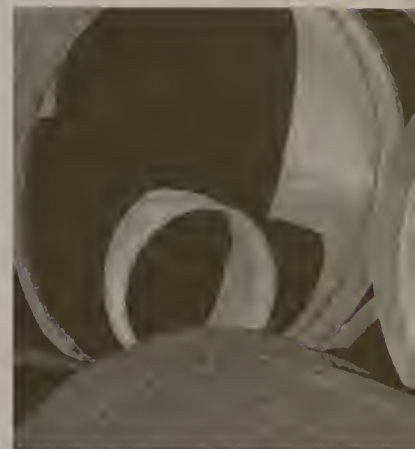
Measured ceiling height to joist in front of basement: 80 inches.

Measured ceiling height to joist in back of basement: 78 inches.

Reviewed by:



Geotechnical
Environmental
Water Resources
Ecological



Attachment C

Updated Revised Supplemental Method 3 Risk Characterization



Infrastructure · Water · Environment · Buildings

Imagine the result

UniFirst Corporation

**Updated Revised
Supplemental Method 3 Risk
Characterization
50 Tufts Street**

Somerville, Massachusetts

April 1, 2011



A handwritten signature in cursive script that reads "Brian Magee".

Brian Magee

A handwritten signature in cursive script that reads "Danielle Pfeiffer".

Danielle Pfeiffer
Senior Scientist

**Updated Revised
Supplemental Method 3
Risk Characterization**

50 Tufts Street
Somerville, Massachusetts

Prepared for:
UniFirst Corporation

Prepared by:
ARCADIS U.S., Inc.
2 Executive Drive
Suite 303
Chelmsford
Massachusetts 01824
Tel 978 937 9999
Fax 978 937 7555

Date:
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EXECUTIVE SUMMARY

Three comprehensive Method 3 Risk Characterizations have previously been prepared for the 50 Tufts Street Site (Release Tracking Number [RTN] 3-23246)(Site). The first was submitted as part of the Phase II Comprehensive Site Assessment (CSA) and Phase III Remedial Action Plan (RAP) in July 2008. The second, a Supplemental Method 3 Risk Characterization, was submitted in May 2009 to respond to comments from the Massachusetts Department of Environmental Protection (MassDEP). In support of the Immediate Response Action Completion (IRAC) Report dated November 2009, a third Revised Supplemental Method 3 Risk Characterization was completed that incorporated data collected at the Site through September 30, 2009. The Supplemental Method 3 Risk Characterization and the Revised Supplemental Method 3 Risk Characterization assumed an exposure duration of 4 hours in residential basements, derived based on observations of current use of basements and consistent with long-established MassDEP guidance (WSC Policy #02-430).

In its Notice of Audit Findings and Notice of Noncompliance dated February 1, 2011 (NOAF/NON), MassDEP directed UniFirst Corporation to submit an “updated Risk Characterization . . . for all residences impacted by vapor intrusion.” For purposes of the “updated Risk Characterization,” MassDEP “recommend[ed] assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors”, provided the basement has at least 7 feet of headroom – notwithstanding MassDEP’s existing guidance to the contrary, and without regard to whether such exposure scenarios either are supported by observations concerning the current or likely future use of basement spaces, or are permitted by local zoning bylaws prohibiting such use in the future.

Without acknowledging and, in fact, expressly disclaiming any technical basis for MassDEP’s recommended approach, this Updated Revised Supplemental Risk Characterization was prepared using MassDEP’s recommended exposure duration of 12 hours in basements with at least 7 feet of headroom, regardless of existing or likely future use conditions for such basements. Indoor air data presented herein for each residence reflect additional data collection and Exposure Pathway Elimination Measure (EPEM) modification measures completed by GEI Consultants, Inc. (GEI) as of February 14, 2011.

Similar to previous risk characterization submittals, this Updated Revised Supplemental Risk Characterization evaluates conditions at the property at 50 Tufts Street in Somerville, Massachusetts (the Property), portions of properties in the neighborhood east and west of the Property, and the Michael E. Capuano Early Childhood Center (the Capuano Center) located at

150 Glen Street in Somerville, Massachusetts. These areas collectively define the “Site” for this Updated Revised Supplemental Risk Characterization.

The Updated Revised Supplemental Risk Characterization supports the IRA Completion Report Amendment prepared by GEI. It summarizes, where applicable, information on Site characterization and Massachusetts Contingency Plan (MCP) compliance. This Updated Revised Supplemental Risk Characterization was conducted in accordance with 310 CMR 40.0900 of the MCP, the MassDEP’s Guidance for Disposal Site Risk Characterization - In Support of the MCP (MassDEP, 1995), and current risk assessment practice in Massachusetts – except for MassDEP’s new recommendation that an exposure duration of 12 hours be used for residential basements with at least 7 feet of headroom regardless of existing or likely future use. The purpose of this Updated Revised Supplemental Risk Characterization is to evaluate potential risk of harm to health, safety, public welfare, and the environment posed by compounds of potential concern (COPCs) associated with the Site, based on currently available data, and to address Required Action No. 2 in the NOAF/NON.

The Updated Revised Supplemental Risk Characterization considered soil, groundwater, soil vapor, ambient air, and indoor air data collected within the Site boundaries. Using a standard screening process, the following compounds were defined as COPCs for soil, groundwater, indoor air, and outdoor air exposures: 1,1-dichloroethane, cis-1,2-dichloroethylene, 1,1-dichloroethylene, tetrachloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, trichloroethylene, and vinyl chloride. Chloroform, chloroethane, and carbon tetrachloride were also defined as COPCs for soil, groundwater, and soil vapor exposures only. The COPC list is consistent with prior Risk Characterization submittals.

Dose-response information was obtained from MassDEP sources, including a document entitled “Revised Proposed Interim Unit Risk Revision for Tetrachloroethylene” (MassDEP, 2008d).

Consistent with prior Risk Characterizations, the Site was divided into the following six exposure areas for the purposes of estimating potential risks: 1) Property, 2) 60 Tufts Street, 3) Tufts Street Area, 4) Alston Street Area, 5) Other Streets Area, and 6) Neighborhood Streets.

The Property exposure area includes the 50 Tufts Street property. The 60 Tufts Street exposure area includes the 60 Tufts Street property. The Tufts Street Area includes the following properties: 9 Tufts Street, 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, 23 Tufts Street, 25 Tufts Street, 27 Tufts Street, and the railroad right-of-way. Samples collected within Tufts Street adjacent to these defined properties were also included in this exposure area. 50 Tufts Street and 60 Tufts Street were not included in this exposure area. The Alston Street Area includes samples collected within Alston Street and the following properties located on the western side of Alston Street: 142-146 Cross Street, 2 Alston Street, 6 Alston Street, 10 Alston Street, 12 Alston Street, 16-20 Alston Street, and 30-40 Alston Street. The Other Streets Area

includes properties along portions of the following streets located north and west of Tufts Street: Glen Street, Morton Street, Knowlton Street, Franklin Street, Franklin Avenue, Palmer Avenue, Hadley Court, Cobble Hill Road, New Washington Street, and Washington Street. The Capuano Center (located at 150 Glen Street) and samples collected within streets adjacent to these defined properties were also included in this exposure area. Finally, the Neighborhood Streets Area, evaluated to assess the Utility Worker receptor, includes all samples collected within the streets located in the boundaries of the Site. This area overlaps the areas designated as “Tufts Street Area,” “Alston Street Area,” and “Other Streets Area” in that it includes the roadways that form a portion of those areas.

The Updated Revised Supplemental Risk Characterization considered both current and future uses of properties within the Site area. Where applicable, receptors included residents, homebound residents, students and teachers at the Capuano Center, resident trespassers, resident visitors, commercial workers, maintenance workers, landscape workers, utility workers, and construction workers. Where applicable, exposure pathways included incidental ingestion and dermal contact with soil, incidental ingestion and dermal contact with groundwater, inhalation of airborne constituents in ambient air, and inhalation of airborne constituents in indoor air. The indoor air Exposure Assessment in this Updated Revised Supplemental Risk Characterization includes an evaluation of homes and commercial properties without an effective vapor mitigation system where a complete indoor air exposure pathway has been identified. This Updated Revised Supplemental Risk Characterization assumes that current vapor mitigation systems within the Property and off-Property buildings will remain in-place in accordance with a properly recorded Activity and Use Limitation (AUL).

An exposure period of 30 years was used to evaluate indoor exposures for current and potential future residents at all residential properties where site-related chlorinated volatile organic compounds (CVOCs) have been detected in either the basement or the first floor living space, except for one residence where an EPEM was modified after February 14, 2011 to eliminate or further mitigate the indoor air pathway. Specifically, this Updated Revised Supplemental Risk Characterization assumes an exposure duration of 5 years for the residence at 95 Franklin Street and a 30-year exposure duration for all other evaluated residential exposures.

The results of the Updated Revised Supplemental Risk Characterization are as follows:

- The total noncarcinogenic Hazard Indices (HIs) for all evaluated scenarios are at or below MassDEP’s target HI of 1. These results indicate that a condition of “No Significant Risk” exists for non-cancer effects of current and future exposures at each exposure area within the Site.

- The total Excess Lifetime Cancer Risks (ELCRs) for all evaluated scenarios are at or below MassDEP's target risk level of 1×10^{-5} , with the exception of residential indoor air risks at 9 Tufts Street, 17 Tufts Street, and 19 Tufts Street, hypothetical future residential indoor air risks at the 91-95 Washington Street commercial property, and potential cumulative indoor/outdoor risks to a future resident at 105-107 Washington Street. After multiple communications with GEI and MassDEP, the residents at 9 Tufts Street, 17 Tufts Street, 19 Tufts Street, and 105-107 Washington have declined mitigation. The ELCR calculations are based on conservative exposure durations and exposure point concentration assumptions. These results indicate that a condition of "No Significant Risk" exists for carcinogenic effects of current and future exposures at each exposure area within the Site, with the exception of indoor air risks at the 9 Tufts Street, 17 Tufts Street, and 19 Tufts Street residential properties, hypothetical future residential indoor air risks at the 91-95 Washington Street commercial property, and potential cumulative indoor/outdoor risks to a future resident at 105-107 Washington Street.

In accordance with 310 CMR 40.0994, the risk of harm to safety and public welfare was evaluated. No overt situations posing a threat of physical harm or bodily injury exist, nor have persistent odors associated with the release been reported following Immediate Response Action (IRA) activities. As such, conditions at the Site do not pose a threat of physical harm or bodily injury, and present no dangerous or nuisance conditions. As part of the public welfare evaluation, soil and groundwater Exposure Point Concentrations (EPCs) across the Site were compared to MassDEP's Upper Concentration Levels (UCLs). Groundwater and soil EPCs are below the UCLs in all cases.

Risk to the Environment was evaluated in this Updated Revised Supplemental Risk Characterization in accordance with MassDEP guidance: Method 3 Environmental Risk Characterization (MassDEP, 1996) and 310 CMR 40.0000 (MassDEP, 2008a). Based on the terrestrial and aquatic habitat evaluation, no "potentially significant exposures" to identified environmental receptors from COPCs likely exist, and a Stage II Environmental Risk Characterization is not necessary. Accordingly, conditions at the Site pose "No Significant Risk" to the Environment.

1.0 INTRODUCTION

This submittal presents the results of an Updated Revised Supplemental Method 3 Risk Characterization for potential exposure pathways associated with Massachusetts Department of Environmental Protection (MassDEP) Release Tracking Number (RTN) 3-23246. The Updated Revised Supplemental Risk Characterization evaluates conditions at the property at 50 Tufts Street in Somerville, Massachusetts (the Property), portions of residential and commercial properties to the east and immediately north, south, and west of the Property, and the Michael E. Capuano Early Childhood Center (the Capuano Center) located at 150 Glen Street in Somerville, Massachusetts. These areas collectively define the “Site” (Figure RC-1).

In July 2008, UniFirst Corporation (UniFirst) of Wilmington, Massachusetts prepared and submitted to the MassDEP a Phase II/Phase III for the Site located at 50 Tufts Street in Somerville, Massachusetts (the Site; Figure RC-1). This report also included a Method 3 Risk Characterization for the Site. MassDEP provided comments on the July 2008 Risk Characterization in its letter to UniFirst dated January 20, 2009 (MassDEP, 2009). MassDEP requested an indoor air Exposure Assessment for each affected residence without an effective vapor mitigation system. On behalf of the Friends and Neighbors of Glen Park, Ms. Anne Marie C. Desmarais of Environmental Insight also provided comments on the July 2008 Risk Characterization in a letter to Ileen Gladstone (GEI) dated January 26, 2009. In May 2009, a Supplemental Method 3 Risk Characterization (Supplemental Risk Characterization) was submitted to MassDEP. The Supplemental Risk Characterization evaluated potential risks using the framework in the July 2008 Method 3 Risk Characterization, but incorporated an Exposure Assessment that addressed MassDEP’s comments in its January 20, 2009 letter. The Supplemental Risk Characterization also addressed the specific comments and questions identified in Ms. Desmarais’ letter (Attachment D). In November 2009, a Revised Supplemental Risk Characterization was prepared to support the IRAC Report prepared by GEI. Potential risks presented in the Supplemental Risk Characterization were updated in the Revised Supplemental Risk Characterization to reflect additional data collection and EPEM modification efforts by GEI. The Supplemental Risk Characterization and the Revised Supplemental Risk Characterization assumed an exposure duration of 4 hours in residential basements, derived based on observations of current use of basements and consistent with MassDEP guidance (WSC Policy #02-430).

In its Notice of Audit Findings and Notice of Noncompliance dated February 1, 2011 (NOAF/NON), MassDEP directed UniFirst Corporation to submit an “updated Risk Characterization . . . for all residences impacted by vapor intrusion.” For purposes of the “updated Risk Characterization,” MassDEP “recommend[ed] assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors”, provided the

basement has at least 7 feet of headroom - notwithstanding MassDEP's existing guidance to the contrary, and without regard to whether such exposure scenarios either are supported by observations concerning the current or likely future use of basement spaces, or are permitted by local zoning bylaws prohibiting such use in the future.

Without acknowledging and, in fact, expressly disclaiming any technical basis for MassDEP's recommended approach, this Updated Revised Supplemental Risk Characterization was prepared using MassDEP's recommended exposure duration of 12 hours in the basement, regardless of existing or likely future use conditions for such basements. Indoor air data presented herein for each residence reflect additional data collection and Exposure Pathway Elimination Measure (EPEM) modification measures completed by GEI Consultants, Inc. as of February 14, 2011.

This Updated Revised Supplemental Risk Characterization was prepared to support the Immediate Response Action Completion (IRAC) Report Amendment prepared by GEI. It summarizes, where applicable, information on Site characterization and Massachusetts Contingency Plan (MCP) compliance. This Updated Revised Supplemental Risk Characterization was conducted in accordance with 310 CMR 40.0900 of the MCP, the MassDEP's Guidance for Disposal Site Risk Characterization - In Support of the MCP (MassDEP, 1995), and current risk assessment practice in Massachusetts – except for MassDEP's new recommendation that an exposure duration of 12 hours be used for residential basements with at least 7 feet of headroom regardless of existing or likely future use. The purpose of this Updated Revised Supplemental Risk Characterization is to evaluate potential risk of harm to health, safety, public welfare, and the environment posed by compounds of potential concern (COPCs) associated with the Site (Release Tracking Number [RTN] 3-23246), based on currently available data, and to address Required Action No. 2 in the NOAF/NON. The boundaries of RTN 3-23246 are depicted in Figure RC-1 and are discussed in Section 2.1 of the IRAC Report.

2.0 RISK CHARACTERIZATION APPROACH

A Method 3 approach to risk characterization was selected for the Site. As specified in the MCP (MassDEP, 2008a), the Method 3 Risk Characterization approach is acceptable for any MCP Site.

The Risk Characterization of harm to human health included four steps. In the first step, Hazard Identification, COPCs are selected for quantitative evaluation in the Updated Revised Supplemental Risk Characterization. The second step, Dose-Response Assessment, describes the relationship between the magnitude of exposure (dose) and the potential occurrence of health effects (response) for each COPC. The third step, Exposure Assessment, identifies potential human receptors based on characteristics of the Site and quantifies the magnitude and frequency of receptors' potential exposure to COPCs. The fourth step, Risk Characterization, combines the information from the previous three steps to derive quantitative estimates of the likelihood for adverse noncarcinogenic health effects or carcinogenic effects.

Potential noncarcinogenic and carcinogenic effects were estimated for each receptor for each potential exposure pathway identified in the Exposure Assessment. The estimated potential risks from each exposure pathway were summed to obtain an estimate of total risk for each receptor. Details on the steps of the human health assessment, as well as the risk characterization of harm to safety, public welfare, and the environment are provided in the remainder of this Appendix.

3.0 HAZARD IDENTIFICATION

The Hazard Identification step includes selection of COPCs for quantitative evaluation in the Updated Revised Supplemental Risk Characterization. COPCs are selected based on a review of data collected from the Site (described in Section 3.1) using several selection criteria (described in Section 3.2).

From approximately 1955 to approximately 2002, the Property, located within the Site, was used for storage and distribution of industrial chemicals, laundry supplies, and dry cleaning supplies. Chemicals stored at and delivered to and from the Property included chlorinated solvents, which contain chlorinated volatile organic compounds (CVOCs). These CVOCs, particularly tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA), have been detected in soil, soil vapor, indoor air, and groundwater at the Property.

3.1 Data Sets

The following sub-sections describe the data collected from various media at the Site.

3.1.1 Soil

As described in the Phase II CSA, surface soil samples, subsurface soil samples, and sub-slab soil samples have been collected from the Property, the neighborhoods to the east and west of the Property, and the Capuano Center. The soil data collected from off-Property areas consist of samples collected in 2004 and from 2006 through March 2008. Consistent with prior Risk Characterizations, these soil samples were used to estimate potential risks at off-Property areas of the Site. Sub-slab soil samples have been collected from off-Property locations subsequent to March 2008. A review of the soil data collected subsequent to March 2008 indicates detectable concentrations of COPCs that are consistent with or less than concentrations in soil considered in the July 2008 Risk Characterization. Therefore, risk estimates presented in the July 2008 Risk Characterization are considered to be a conservative representation of current exposures to soil at the Site.

Soil samples collected from the Property prior to the commencement of the soil vapor extraction (SVE) system in April 2007 are not considered to be representative of current subsurface conditions on the Property. Therefore, soil data used to assess potential risks at the Property included only post-remediation soil samples.

Tables 1a through 1f of Attachment C present the soil data used to estimate potential exposures in this human health Updated Revised Supplemental Risk Characterization. Table RC-1 provides the frequency of detection for the relevant soil data collected from within the Site

boundaries. Soil sample locations are depicted on Figures 4-1 and 4-2 of the July 2008 Phase II CSA. These figures are also presented in Attachment C of this document.

3.1.2 Groundwater

Groundwater samples have been collected from 12 monitoring wells at the Property and 27 off-Property monitoring wells during multiple sampling rounds. Consistent with prior Risk Characterizations, all groundwater data used in this assessment were collected by GEI from May 2006 through April 2008. A review of groundwater data collected at the Site subsequent to April 2008 indicates detectable concentrations of COPCs that are consistent with or less than concentrations in groundwater considered in the July 2008 Risk Characterization. Therefore, risk estimates presented in the July 2008 Risk Characterization are a conservative representation of current exposures to groundwater at the Site.

Elevated laboratory reporting limits were reported for several compounds in MW-1 during the April 2007 sampling event. Therefore, these reporting limits were not included in calculations to determine the temporal average at MW-1, nor were they used to estimate exposure point concentrations (EPCs) for non-detect samples (see Section 5). Tables 2a through 2f of Attachment C present the groundwater data used to estimate potential exposures in this human health Updated Revised Supplemental Risk Characterization. Because the depth to groundwater in the vicinity of the Property ranges from 5 to 15 feet below ground surface (ft bgs), potential human exposure to groundwater is assumed to occur only during hypothesized future utility work activities and dewatering during construction activities. Table RC-1 provides descriptive statistics (i.e., frequency of detection, minimum, average and maximum concentrations) for all groundwater data collected from the Site through February 2011.

3.1.3 Soil Vapor

Consistent with prior Risk Characterizations, soil vapor samples used in this Updated Revised Supplemental Risk Characterization were collected by GEI from January 2007 through April 2008. During this period, soil vapor samples were collected from 20 locations within the Site boundaries during several rounds of investigation. Potential exposures of construction and utility workers were estimated using soil vapor data collected from monitoring wells equipped with a soil vapor sampling port and valve.

Soil vapor samples collected during soil vapor extraction system testing conducted in July 2007 on the Property (samples SVT-8D, SVT-14S, and SVT-22D) were not used in the Updated Revised Supplemental Risk Characterization because they are not representative of current conditions because the sub-slab depressurization system (SSDS) and SVE system continue to operate. Sub-slab soil vapor data were not used to estimate potential risks to utility and

construction workers because such data are not representative of the soil vapor in areas reasonably anticipated to affect such workers.

Tables 3a through 3f of Attachment C present the soil vapor data used to estimate potential exposures in this human health Updated Revised Supplemental Risk Characterization. Refer to the Phase II CSA for a description of soil vapor point installation and sampling techniques.

3.1.4 Indoor Air

3.1.4.1 The Property

In 2007 and 2008, GEI collected indoor air samples at six locations within the building at the Property (North Office, South Office, North Warehouse, North Central Warehouse, South Central Warehouse, and Garage Area). Indoor air samples collected in the Property building prior to the commencement of the SSDS in April 2007 are not representative of current conditions. Therefore, indoor air samples collected within the Property building subsequent to installation of the SSDS and SVE system (during sampling rounds in October 4, 2007, December 7, 2007, May 2008, and March 2009) were used in this Updated Revised Supplemental Risk Characterization to assess potential exposures to indoor air in the Property building. The locations of indoor air samples collected within the Property building are depicted on Figure 6-3 of the Phase CSA II. This figure is also presented in Attachment C of this document.

3.1.4.2 Residential and Commercial Properties

As summarized in Section 7-4 of the July 2008 Phase II CSA, GEI evaluated soil vapor intrusion as a potential indoor exposure pathway in off-Property areas based on site-wide groundwater, soil, and indoor air sampling results. The evaluation included a program of sub-slab soil vapor testing and indoor air testing at residential and commercial properties within a several-block area near the Property.

Similar to prior Risk Characterizations, the indoor air Exposure Assessment in this Updated Revised Supplemental Risk Characterization includes an evaluation of homes and commercial properties where a complete vapor intrusion exposure pathway has been identified. As stated in the MCP (310 CMR 40.0414(3), the standard for an Immediate Response Action implemented to address a CEP is to eliminate or mitigate the exposure pathway to the extent feasible. The standard for demonstrating that a remedial measure has been effective, however, is whether "a level of no significant risk of harm to health, public welfare and the environment exists or has been achieved" (see 310 CMR 40.0941(3); 310 CMR 40.0993(7) & (8)).

To date, EPEMs have been installed at 22 off-Property buildings (20 residential properties, 1 commercial property, and the Capuano Center). Subsequent to installation of the EPEMs, GEI has monitored and inspected mitigation measures in accordance with the IRA Plan and, subsequently, the Phase IV Remedy Implementation Plan (RIP). Based on post-mitigation indoor air sampling, EPEMs have eliminated the vapor intrusion pathway and achieved a Condition of No Significant Risk for the following 12 properties: 91-93 Franklin Street, 95R Franklin Street, 166-168 Glen Street, 9 Knowlton Street, 13 Knowlton Street, 31-33 Knowlton Street, 32 Knowlton Street, 35-37 Knowlton Street, 11 Morton Street, 13 Morton Street, 60 Tufts Street (Units 1, 5, 10, and 16), and 103 Washington Street. This Updated Revised Supplemental Risk Characterization assumes that current vapor mitigation systems within the Property and off-Property buildings will remain in-place in accordance with a properly recorded Activity and Use Limitation (AUL).

Indoor air samples within 10 residential properties (4 Morton Street, 10 Morton Street, 12 Morton Street, 18 Morton Street, 19-19A Morton Street, 95 Franklin Street, 17 Knowlton Street, 60 Tufts Street Unit 4, 23 Tufts Street, and 27 Tufts Street), indicate that the vapor intrusion pathway has not been eliminated, so potential exposures to indoor air were evaluated in this Updated Revised Supplemental Risk Characterization. The dataset considered in this Updated Revised Supplemental Risk Characterization for 4 Morton Street, 10 Morton Street, 12 Morton Street, 18 Morton Street, 19-19A Morton Street, 95 Franklin Street, 17 Knowlton Street, 60 Tufts Street Unit 4, 23 Tufts Street, and 27 Tufts Street consist of indoor air samples collected subsequent to the installation or modification of the EPEMs through February 14, 2011.

As discussed in the IRAC Report and IRAC Report Amendment, several residences have refused remediation measures. In addition, it has been determined to be infeasible to mitigate the CEPs for several residences with low CVOC concentrations in indoor air because the cost of the measures that would be required to eliminate or mitigate these low concentrations is substantial, based on a site-specific evaluation of building construction and other conditions. This Updated Revised Supplemental Risk Characterization evaluates potential indoor air exposures for the following residences for which the vapor intrusion pathway has been confirmed, but for which an EPEM has not been installed: 6-8 Morton Street, 162-164 Glen Street, 12-14 Knowlton Street, 23 Knowlton Street, 97 Franklin Street, 99 Franklin Street, 9 Tufts Street (Left and Right Units), 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, 25 Tufts Street, 105-107 Washington Street, 111 Washington Street, and 49 Tufts Street. In addition, this Updated Revised Risk Characterization evaluates potential indoor air exposures for the following 5 commercial properties for which the vapor intrusion pathway has been confirmed, but for which an EPEM has not been installed: 163 Glen Street, 85 Washington Street, 91-95 Washington Street, 97 Washington Street, and 121 Washington Street.

GEI was refused access to conduct sub-slab and/or indoor air sampling at the residential properties located at 12 Alston Street and 159 Glen Street. As a result, insufficient data are currently available to determine if potential exposures exist within these two buildings.

The residential garage located at 10 Alston Street and the commercial garage located at 34 Knowlton Street do not contain living spaces and are not classified as occupied buildings. Based on the current use of these properties, the vapor intrusion exposure pathway was not evaluated.

Four rounds of indoor air samples have been collected from the first floor living space and the adjacent parking garage at 2 Hadley Court #2a. Low levels of TCA were detected in the garage during one sampling round (July 2008); however, no CVOCs were detected within the first-floor living space during the four indoor air sampling rounds. Since the garage is not classified as an occupied building, the vapor intrusion pathway has not been evaluated for this property.

As discussed in the IRAC Report, GEI observed significant quantities of dry cleaning related chemicals and solvents in the basement of the residence located at 9 Knowlton Street. Although an EPEM has been installed at this property based on sub-slab soil vapor sampling results, concentrations detected in the indoor air at 9 Knowlton Street are not attributable to the disposal site. Indoor air data for this property were not considered in this Risk Characterization.

The commercial building at 30-40 Alston Street is occupied by a costume shop (Costume Works located at 32 Alston Street) and a printing shop (Flagraphics, Inc. located at 40 Alston Street). Alston Street is upgradient and south of the Property. On March 8, 2007, two sub-slab soil vapor samples were collected from beneath the costume shop, and four sub-slab soil vapor samples were collected from beneath the printing shop. PCE concentrations in these samples ranged from below the method reporting limit ($1.4 \mu\text{g}/\text{m}^3$) to $9.5 \mu\text{g}/\text{m}^3$ in sample SS5 collected beneath the printing shop. Because PCE was not detected in soil and groundwater samples collected from Alston Street, and because sub-slab vapor concentrations of PCE were less than the MassDEP-provided sub-slab vapor intrusion action level, detected concentrations of CVOCs within the indoor air of 30-40 Alston Street were attributed to sources associated with operations of the current businesses. Potential exposure to CVOCs migrating from the subsurface to indoor air in this building is not a complete exposure pathway, and potential risks associated with exposure to indoor air are not evaluated in this Risk Characterization.

As discussed in the IRAC Report and IRAC Report Amendment, the following four properties have had measurable concentrations of CVOCs in indoor air, but there is not a complete vapor intrusion pathway and the concentrations are not attributable to the disposal site: 16-20 Alston Street, 76 Franklin Street, 45-47 Tufts Street, and 51-51A Tufts Street. As such, potential risks

associated with exposure to indoor air are not evaluated for these four properties in this Risk Characterization.

In addition to the EPEMs discussed above, an SSDS is currently operating at the Capuano Center. Detailed descriptions of the previous sampling efforts, testing results from December 2006 through March 2009, and a description of the design and installation of the SSDS were documented in IRA Status Report No. 1 (RTN 3-26114), IRA Status Report Nos. 3 through 7 (RTN 3-23246), the IRAC Report, and Phase IV Status Reports Nos. 1 through 3. Indoor air samples collected prior to Response Actions are not representative of current conditions. The vapor intrusion pathway was not evaluated at the Capuano Center because the pathway is incomplete.

Indoor air data evaluated in this Risk Characterization are summarized in Table 4a through 4f of Attachment C. Table RC-2 provides the frequency of detection for all indoor air data collected from the Site through February 14, 2011.

3.1.5 Outdoor Air

Outdoor air data used in this Updated Revised Supplemental Risk Characterization were collected by GEI in 2006 and 2008 from on-Property and off-Property locations. Outdoor air sample locations were depicted on Figure 7-6 of the Phase II CSA submitted to the MassDEP in July 2008. This figure is also presented in Attachment C of this document. These samples were used to estimate potential exposures to outdoor air at the Site.

Outdoor air samples collected at the Property (North Parking Lot and South Parking Lot samples) in August 2007 are not representative of current conditions at the Property because a soil stockpile was present during the sampling event. The stockpile was generated during the installation of the SVE system and was removed from the Property subsequent to the outdoor air sampling round. Potential exposures to outdoor air at the Property were estimated using samples collected during other rounds of investigation.

Tables 5a through 5f of Attachment C presents outdoor air data considered in this human health Updated Revised Supplemental Risk Characterization. Table RC-3 provides the frequency of detection for all outdoor air data collected within the Site boundaries.

3.2 Exposure Areas

Consistent with the prior Risk Characterizations, the Site was divided into the following six exposure areas for the purposes of estimating potential risks:

- **Property:** This exposure area includes the 50 Tufts Street property. The results from soil, groundwater, indoor air, and outdoor air samples were used to estimate potential risks for receptors in this area.
- **60 Tufts Street:** This exposure area includes a portion of the 60 Tufts Street property. The results from soil, groundwater, soil vapor, and outdoor air samples were used to estimate potential risks for receptors in this area. Samples collected along Tufts Street were not included in this exposure area. In addition, indoor air samples were used to estimate potential risks for the residential occupant of 60 Tufts Street, Unit 4.
- **Tufts Street Area:** This exposure area includes the following properties: 9 Tufts Street, 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, 23 Tufts Street, 25 Tufts Street, 27 Tufts Street, and the railroad right-of-way. Samples collected within Tufts Street adjacent to these defined properties were also included in this exposure area. 50 Tufts Street and 60 Tufts Street were not included in this exposure area. The results from soil, groundwater, soil vapor, and outdoor air samples were used to estimate potential risks for receptors in this area. In addition, indoor air samples were used to estimate potential risks for the residential properties located at 9 Tufts (Left and Right Units), 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, 23 Tufts Street, 25 Tufts Street, and 27 Tufts Street.
- **Alston Street Area:** This exposure area includes samples collected within Alston Street and the following properties located on the western-side of Alston Street: 142 Cross Street, 2 Alston Street, 6 Alston Street, 10 Alston Street, 12 Alston Street, 16-20 Alston Street, and 30-40 Alston Street. The results from soil, groundwater, soil vapor, and outdoor air samples were used to estimate potential risks for receptors in this area. Samples collected from MW-105 located approximately 50 feet north of Alston Street, along Cross Street, were also included in this dataset. As discussed in Section 3.4.1, potential exposures to CVOCs in indoor air were not assessed at the commercial building located at 30-40 Alston Street or the residence located at 16-20 Alston Street because detected concentrations of CVOCs within the indoor air were not attributable to the disposal site. To date, GEI has been refused access to sample the indoor air at 12 Alston Street.
- **Other Streets Area:** This exposure area includes portions of the following streets located north and west of Tufts Street: Glen Street, Morton Street, Knowlton Street, Franklin Street, Franklin Avenue, Palmer Avenue, Hadley Court, Cobble Hill Road, New Washington Street, and Washington Street. The Capuano Center (located at 150 Glen Street) and samples collected within streets adjacent to these defined properties were also included in this exposure area. The results from soil, groundwater, soil vapor, and outdoor air samples were used to estimate potential risks for receptors in this area. In

addition, indoor air samples were used to estimate potential risks for the following commercial properties in this area: 163 Glen Street, 85 Washington Street, 91-95 Washington Street, 97 Washington Street, and 121 Washington Street. Indoor air samples also were used to estimate potential risks for the current residential properties located at: 162-164 Glen Street, 49 Tufts Street, 95 Franklin Street, 12-14 Knowlton Street, 17 Knowlton Street, 97 Franklin Street, 99 Franklin Street, 23 Knowlton Street, 6-8 Morton Street, 10 Morton Street, 12 Morton Street, 18 Morton Street, 19-19A Morton Street, 105-107 Washington Street, and 111 Washington Street. As discussed in Section 3.4.1 and the IRAC Report Amendment, potential exposures to CVOCs in indoor air were not assessed at the residences located at 51-51a Tufts Street, 45-47 Tufts Street, and 76 Franklin Street because detected concentrations of CVOCs within the indoor air were not attributable to the disposal site.

- **Neighborhood Streets:** For the Utility Worker receptor, this exposure area includes samples collected within all streets located within the Site boundaries. This area overlaps with the areas designated as “Tufts Street Area,” “Alston Street Area,” and “Other Streets Area” in that it includes the roadways that form a portion of those areas. The results from soil, groundwater, and soil vapor samples from the roadways were used to estimate potential risks for utility worker receptors in this area.

The boundaries of these exposure areas are depicted on Figure RC-1. Table RC-4 lists soil, groundwater, soil vapor, and outdoor air samples that were considered in this Updated Revised Supplemental Risk Characterization within each of the above-defined exposure areas. Property and off-Property soil, groundwater, soil vapor, outdoor air, and indoor air data considered in this Updated Revised Supplemental Risk Characterization are summarized in Attachment C.

3.3 Selection of COPCs

Consistent with prior Risk Characterizations, a multiple-step screening procedure was used to identify COPCs for quantitative evaluation in the Updated Revised Supplemental Risk Characterization. First, samples collected from the Property were evaluated to identify compounds that potentially may be associated with RTN 3-23246. If a compound was not detected at a concentration above its laboratory reporting limit in subsurface samples (soil, groundwater, and soil vapor) collected from the Property, then it was not selected as a COPC in any medium in any area. Samples evaluated in this step included:

- Soil samples collected from the Property from July 2002 through February 2011 (with the exception of samples collected to characterize soil for disposal purposes);
- Groundwater samples collected from the Property from January 2007 through February 2011; and

- Soil vapor samples collected from the Property between January 2007 and February 2011 (including samples collected during evaluation of the remediation system in July 2007, but excluding samples collected from beneath the slab of the Property building).

Table RC-1 identifies compounds detected in at least one soil, groundwater, and/or soil vapor sample collected from the Property data considered in this report, as discussed in Section 3.1. Compounds that were not detected in any sample from the Property were eliminated from the COPC screening process. A total of 31 compounds were detected in at least one sample and were retained for evaluation in the second step of the COPC screening process.

In the second step, if a compound was detected at a very low frequency ($\leq 5\%$) in all three media (soil, groundwater, and soil vapor), it was excluded as a COPC. The frequency of detection was based on samples collected from within the Site boundaries, including samples collected on the Property. A total of 15 compounds were detected at a frequency of less than or equal to 5%, and were eliminated from the COPC screening process. A total of 16 compounds were detected with a frequency greater than 5% and were retained for evaluation in the third step of the COPC screening process.

In the third step, if detected concentrations of a compound were higher in off-Property samples than the maximum concentration detected in samples from the Property, and if the compound was not consistent with historical operations at the Property, then it was eliminated from the COPC screening process. The following compounds were eliminated in this step of the COPC screening process: benzene, 1,2-dichloroethane, methyl tert-butyl ether, naphthalene, and toluene.

Using this screening process, the following eleven compounds were selected as COPCs: vinyl chloride, TCE, TCA, trans-1,2-dichloroethylene, PCE, 1,1-dichloroethylene, cis-1,2-dichloroethylene, 1,1-dichloroethane, chloroform, chloroethane, and carbon tetrachloride. The COPC screening process is summarized in Table RC-1 of this report. A review of additional data collected subsequent to the submittal of the July 2008 Risk Characterization did not result in additions to or deletions from the previously presented COPC list. Therefore, the COPC list selected in this Updated Revised Supplemental Risk Characterization is consistent with the list presented in prior Risk Characterizations.

Analytical results for certain COPCs detected in indoor and outdoor air samples were questionable, based on a review of groundwater sample results, and a determination of whether the compound is a breakdown product of the chlorinated solvents detected on the Property. A technical review indicated that detected concentrations of the following compounds in indoor air and outdoor air are not associated with RTN 3-23246: chloroform, chloroethane, and carbon

tetrachloride. As a result, these compounds were not considered COPCs in indoor air or outdoor air. The rationale for this determination is described below for each compound:

- Chloroform – Chloroform has been detected at low concentrations (0.88J to 13.3 µg/L) in groundwater samples from five wells (SH-4, SH-MW1, SH-MW3, MW-1, and MW-3). These concentrations are well below MassDEP's Method 1 GW-2 Standard (50 µg/L), which is protective of residential exposure to indoor air. It was not detected in wells adjacent to any residence evaluated in the Updated Revised Supplemental Risk Characterization, and therefore, would not contribute significantly to potential indoor air exposures. Chloroform is commonly present in environmental samples as a result of laboratory sample processing and is not a degradation product of the chlorinated solvents detected at the Property.
- Chloroethane – Chloroethane has only been detected in one off-Property monitoring well located approximately 400 feet downgradient from the Property boundaries (MW-116) at levels slightly above the laboratory reporting limit (2.3 and 2.4 µg/L); and therefore, does not pose a risk of impacting indoor air quality.
- Carbon Tetrachloride – Carbon tetrachloride was not detected in soil or groundwater samples collected outside the boundaries of the Property. In addition, carbon tetrachloride was above the laboratory reporting limit in only one indoor air sample collected within the off-Property portion of the Site. Further, carbon tetrachloride was detected in all outdoor air samples at similar values because of its ubiquitous nature in ambient air.

4.0 DOSE-RESPONSE ASSESSMENT

The purpose of the Dose-Response Assessment is to identify the relationship between the magnitude of COPCs to which receptors may be exposed (dose) and the likelihood of an adverse health effect (response). Both noncarcinogenic (i.e., threshold) and carcinogenic (i.e., non-threshold) health effects were considered in the dose-response assessment. The information provided in the Dose-Response Assessment was combined with the results of the Exposure Assessment (Section 5) to provide an estimate of potential health risk.

Dose-response information used in this Updated Revised Supplemental Risk Characterization was obtained from MassDEP publications (MassDEP, 2008b), including a document entitled "Revised Proposed Interim Unit Risk Revision for Tetrachloroethylene" (MassDEP, 2008d).

Toxicity values for chloroethane were not available from MassDEP Publications. Therefore, toxicity values for chloroethane were obtained from U.S. Environmental Protection Agency's (U.S. EPA's) Integrated Risk Information System. The toxicity data used in this Updated Revised Supplemental Risk Characterization are shown in Table RC-5.

4.1 Noncarcinogenic Dose-Response

Compounds with known or potential noncarcinogenic effects were assumed to have a dose below which no adverse effect occurs, or conversely, above which an effect may be seen. In laboratory experiments, this dose is known as the "No Observed Adverse Effect Level" (NOAEL). The lowest dose at which an adverse effect is seen is called the "Lowest Observed Adverse Effect Level" (LOAEL). By applying uncertainty factors to the NOAEL or the LOAEL, Reference Doses (RfDs) and Reference Concentrations (RfCs) are developed for chronic and, in some cases, subchronic, exposures to compounds with potential noncarcinogenic effects. Many of the noncarcinogenic dose-response values provided by MassDEP (2008b) were developed by the U.S. EPA and are reported in U.S. EPA (2008), while other values provided in MassDEP (2008b) were developed by MassDEP.

Uncertainty factors account for uncertainties associated with the dose-response data, such as the appropriateness of using an animal study to derive a human dose-response value, and the potential for especially sensitive subpopulations to exist, which may not be adequately represented by the laboratory test animals. For compounds with potential noncarcinogenic effects, the RfD or RfC provides reasonable certainty that, if the specified exposure dose is below the threshold, then no noncarcinogenic health effects are expected to occur. RfDs are expressed in terms of milligrams of compound per kilogram of body weight per day (mg/kg-day) and are used to evaluate estimated oral and dermal exposures. RfCs are expressed in terms of milligrams of compound per cubic meter of air (mg/m³) and are used to evaluate estimated

inhalation exposures in a specific exposure context (continuous exposure for a chronic period of time). Table RC-5 summarizes the toxicity values for the COPCs evaluated here by the inhalation and oral / dermal exposure routes.

4.2 Carcinogenic Dose-Response

The U.S. EPA assumes for regulatory risk assessment of carcinogenic effects that no threshold dose exists (U.S. EPA, 1990, 1997). In other words, U.S. EPA assumes that a finite level of risk may be associated with any dose above zero. In March 2005, U.S. EPA issued new cancer guidelines (U.S. EPA, 2005), the purpose of which is to recommend principles and procedures to guide U.S. EPA scientists in assessing the cancer risks from chemicals or other agents in the environment when deriving toxicity values. U.S. EPA uses a two-part system for characterizing the extent to which the available data support the hypothesis that an agent causes cancer in humans.

U.S. EPA's first step in evaluating a potential carcinogen is to assign a weight-of-evidence (WOE) classification. Under U.S. EPA's previous cancer guidelines released in 1986, the WOE was described by categories "Group A" through "Group E", with Group A category reserved for known human carcinogens, while Group E category was the other end of the spectrum, representing compounds/agents with evidence of non-carcinogenicity. In the U.S. EPA's more recent approach for carcinogen risk assessment (U.S. EPA, 2005), all scientific information is considered in determining whether and under what conditions an agent may cause cancer in humans. Furthermore, the WOE provides a narrative approach to characterize carcinogenicity rather than distinct categories by summarizing the evidence about the likelihood of the compound being a human carcinogen. Five standard WOE descriptors are currently used as part of the narrative, including:

1. Carcinogenic to Humans
2. Likely to be Carcinogenic to Humans
3. Suggestive Evidence of Carcinogenic Potential
4. Inadequate Information to Assess Carcinogenic Potential
5. Not Likely to be Carcinogenic to Humans

As part of the updated guidance on evaluating potentially carcinogenic compounds, the U.S. EPA emphasizes the value of understanding the biological changes that the agent of interest can cause (e.g., mode of action) and how these changes might lead to the development of cancer. This information, as well as the agent's human carcinogenic potential, is to be described in a narrative prepared by U.S. EPA's scientists, summarizing the full range of

available evidence and describing any conditions associated with conclusions about an agent's hazard potential, including which populations or life stages may be particularly susceptible. Because the data for many of the potentially carcinogenic compounds have not been re-evaluated since the initial derivation of the cancer slope factors under the 1986 cancer guidelines, the cancer toxicity information presented in Integrated Risk Information System (IRIS) - U.S. EPA's database of recommended cancer slope factors and reference doses for use in risk assessments) represents cancer toxicity information derived under the 1986 guidelines, with more recent cancer evaluations conducted for a limited number of compounds under the more recent 2005 guidance (U.S. EPA, 2008).

The second step in the carcinogenicity evaluation process is the calculation of a quantitative estimate of carcinogenic potency. The U.S. EPA has developed computer models that extrapolate the observed responses at high doses used in animal studies to predict responses in humans at the low doses encountered during environmental exposures. The models developed by the U.S. EPA assume no threshold and usually consider animal (and sometimes human) data to estimate carcinogenic potency. Further, the models assume that carcinogenic dose-response is linear at low doses. U.S. EPA refers to this numerical estimate of the dose response factor (or the slope of the line plotted from dose vs. response) as the cancer slope factor (CSF) for oral exposures. For inhalation exposures, the numerical estimate is expressed as either a unit risk (UR) factor or CSF. A CSF is expressed in terms of the inverse of milligrams of agent per kilogram body weight per day $[(\text{mg/kg-day})^{-1}]$ and represents the upper-bound excess lifetime cancer risk estimate that results from a daily lifetime exposure to an agent at a dose of 1 mg/kg-day. The UR is expressed in terms of the inverse of micrograms per cubic meter $[(\mu\text{g/m}^3)^{-1}]$ and represents the upper-bound excess lifetime cancer risk estimated to result from continuous daily lifetime exposure to an agent at a concentration of 1 $\mu\text{g/m}^3$ in air. Table RC-5 summarizes carcinogenic toxicity values for COPCs used in this Updated Revised Supplemental Risk Characterization.

5.0 EXPOSURE ASSESSMENT

5.1 Receptors and Exposure Pathways

Consistent with the requirements of the MCP (310 CMR 40.0923), the exposure assessment considered both current and reasonably foreseeable future activities and uses at the Site. Receptors at the Site are summarized in the following subsections.

5.1.1 The Property

The Property is approximately 51,111 square feet (sf) and is located at 50 Tufts Street in Somerville, Massachusetts. The Property is currently developed with an approximately 20,594-sf, one-story, masonry block building. The majority of the building is warehouse space, and small areas used as office space are within the north and south portion of the Property building. Approximately 95 percent of the Property is surrounded by a chain-linked fence. Figure 1-2 of the IRAC Amendment shows the location of the Property. This figure is also presented in Attachment C of this document.

The building at the Property is generally unoccupied and there are currently no tenants; however, maintenance / repair personnel may be present infrequently and the building may be leased to tenants in the near future. Therefore, the building was conservatively assumed to be currently occupied at a frequency and duration of a full-time indoor and outdoor commercial worker. Other current use receptors at the Property as currently constructed consist of local residents who may trespass at the property and maintenance workers/landscapers who occasionally visit the property to perform routine activities. The potentially complete exposure pathways for these receptors include incidental ingestion and dermal contact with accessible surficial soil (0 to 3 ft bgs), and inhalation of soil derived particulates and volatiles in ambient air. Groundwater at the Property is not currently used (and is not expected to be used in the future) as a potable water source. Groundwater underlying the Property meets none of the definitions of a Current or Potential Drinking Water Source Area and as such is not categorized as GW-1. The inhalation of COPCs within indoor air of the building was also evaluated as a current exposure pathway for the indoor/outdoor commercial worker receptor.

Future use receptors at the Property consist of future construction workers during potential future excavation/development activities, utility workers during emergency repair or future development activities, outdoor employees of future commercial buildings, visitors to potential future commercial buildings, indoor employees of future commercial buildings, residents of future residential developments and landscapers. Complete exposure pathways for these future receptors are summarized below:

- The potentially complete exposure pathways for the Property construction worker receptor include incidental ingestion and dermal contact with soil located between 0 and 15 ft bgs, inhalation of particulates within ambient air, and the inhalation of volatiles from soil, soil vapor, and/or groundwater. It was assumed that dewatering will occur prior to future construction activities and that direct contact with groundwater during construction will be minimal. Therefore, a construction worker's incidental ingestion and dermal contact with groundwater were not quantitatively assessed in the Updated Revised Supplemental Risk Characterization.
- The potentially complete exposure pathways for the Property utility worker receptor include incidental ingestion and dermal contact with soil located between 0 and 6 ft bgs, inhalation of particulates within ambient air, and the inhalation of volatiles from soil, soil vapor, and/or groundwater and incidental ingestion and dermal contact with groundwater within future trench excavations.
- The potentially complete exposure pathways at the Property for the future outdoor employees of the commercial building, future visitors, future residents, and future landscapers include incidental ingestion and dermal contact with accessible 0 to 3 ft bgs soils and inhalation of particulates and volatiles within ambient air. It is assumed that vapor barriers or other measures will be integral to the design and construction of any future buildings at the Property, whether commercial or residential. Therefore, indoor air is not a complete exposure pathway for future residential or commercial receptors. Future outdoor employees of the commercial building, future visitors, future residents, and future landscapers could also be exposed to potentially accessible soils located 0 to 15 ft bgs that may have been relocated to the surface during property development activities.

5.1.2 Off-Property areas

The area surrounding the Property is characterized by residential and commercial development. Public properties include a primary school, a playground, community gardens, and public streets. Current use receptors in the off-Property portion of the Site consist of local residents, indoor and outdoor employees of commercial buildings, visitors to residences and commercial buildings, landscapers, railroad workers who may perform maintenance on nearby tracks, and students and teachers at the Capuano Center. The potentially complete exposure pathways for these current receptors include incidental ingestion and dermal contact with accessible surficial soil (0 to 3 ft bgs), inhalation of soil derived particulates and volatiles in ambient air, and inhalation of volatiles in indoor air. Groundwater is not currently used (and is not expected to be used in the future) as a potable water source. Groundwater meets none of the definitions of a Current or Potential Drinking Water Source Area and as such is not categorized as GW-1.

GEI established a property evaluation process, which was presented in IRA Plan Modification No. 1, dated April 12, 2007, to evaluate off-Property residential and commercial buildings and address identified current vapor intrusion pathways. The evaluation process was further detailed in IRA Status Report No. 4. Based on sampling results, remedial actions have been conducted at the Capuano Center to mitigate the indoor air exposure pathway and, to date, EPEMs have also been installed in 21 additional buildings (20 residential properties and 1 commercial building). This Updated Revised Supplemental Risk Characterization does not evaluate indoor air exposures within the following off-Property buildings in which EPEMs have been installed because the vapor migration pathway is not complete, and it is assumed that EPEMs will continue to operate in accordance with a properly recorded AUL: Capuano Center, 91-93 Franklin Street, 95R Franklin Street, 166-168 Glen Street, 9 Knowlton Street, 13 Knowlton Street, 31-33 Knowlton Street, 32 Knowlton Street, 35-37 Knowlton Street, 11 Morton Street, 13 Morton Street, 60 Tufts Street (Units 1, 5, 10, and 16), and 103 Washington Street.

This Updated Revised Supplemental Risk Characterization includes an updated evaluation of potential indoor air exposures for occupied buildings in which a complete indoor air pathway currently exists. Off-Property commercial and residential buildings at which the indoor air pathway is complete and therefore evaluated in this Updated Revised Supplemental Risk Characterization are summarized below:

- 4 Morton Street, 10 Morton Street, 12 Morton Street, 18 Morton Street, 19-19A Morton Street, 17 Knowlton Street, 60 Tufts Street Unit 4, 23 Tufts Street, and 27 Tufts Street). COCs were measured in concentrations above reporting limits after installation of EPEMs in each of these residences. Only post-EPEM modification samples are considered in this Risk Characterization.
- 95 Franklin Street: Due to post-mitigation detects of CVOCs within this residence, the indoor air pathway cannot be ruled out at this time. EPEM modifications were recently made to eliminate or further mitigate the indoor air pathway; therefore, this Updated Revised Supplemental Risk Characterization assumes the indoor air pathway will be mitigated within a 5-year time period.
- 6-8 Morton Street, 162-164 Glen Street, 12-14 Knowlton Street, 23 Knowlton Street, 97 Franklin Street, 99 Franklin Street, 9 Tufts Street (left and Right Units), 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, 25 Tufts Street, 105-107 Washington Street, 111 Washington Street, and 49 Tufts Street. After several requests by GEI and MassDEP, the owners of 105-107 Washington, 111 Washington, 99 Franklin Street, 9 Tufts Street (Left and Right Units), 11-13 Tufts Street, 17 Tufts Street, 19 Tufts Street, and 25 Tufts Street have declined installation of an EPEM in their buildings. With respect to the

remaining properties, it has been determined to be infeasible to mitigate the CEPs for these residences with low CVOC concentrations in indoor air because the cost of the measures that would be required to eliminate or mitigate these low concentrations is substantial, based on a site-specific evaluation of building construction and other conditions.

- 163 Glen Street, 85 Washington Street, 91-95 Washington Street, 97 Washington Street, and 121 Washington Street. Indoor air data collected at these commercial properties are used to quantify indoor air exposures to current commercial workers, future commercial workers, and hypothetical future residents.

Two different residential receptors were considered in this Updated Revised Supplemental Risk Characterization: a “homebound resident” exposed via the indoor air pathway only and a “resident” exposed via both indoor and outdoor exposure pathways. Exposure assumptions are further described in Section 5.7 of this report.

Future use receptors of the off-Property areas of the Site consist of future construction workers during potential future excavation/development activities, utility workers during emergency in-street repairs or installations, indoor and outdoor employees of commercial buildings, visitors to commercial buildings, residents, and students and teachers of the Capuano Center. Complete exposure pathways for these receptors are summarized below:

- The potentially complete exposure pathways for the construction worker receptor include incidental ingestion and dermal contact with soil located between 0 and 15 ft bgs, inhalation of particulates within ambient air, and the inhalation of volatiles from soil, soil vapor, and/or groundwater. It was assumed that dewatering will occur prior to future construction activities and that direct contact with groundwater will be minimal. Therefore, a construction worker’s incidental ingestion and dermal contact with groundwater were not quantitatively assessed in this Updated Revised Supplemental Risk Characterization.
- The potentially complete exposure pathways for the utility worker receptor include incidental ingestion and dermal contact with soil located between 0 and 6 ft bgs, inhalation of particulates within ambient air, and the inhalation of volatiles from soil, soil vapor, and/or groundwater and incidental ingestion and dermal contact with groundwater within future trench excavations.
- The potentially complete future exposure pathways for outdoor employees in commercial buildings, visitors to commercial buildings, residents, and students and teachers of the Capuano Center include incidental ingestion and dermal contact with soil (0 to 15 ft bgs,

including sub-slab soil) that may have been relocated to the surface during property development activities, inhalation of soil derived particulates and volatiles in ambient air. The indoor air exposure pathway within commercial properties that are developed as residential in the future is also considered in this Updated Revised Supplemental Risk Characterization.

5.2 Soil and Groundwater Categorization

For this Updated Revised Supplemental Risk Characterization, soil categories were identified for current and future Site conditions. Based on potential exposures for the most sensitive current receptors (the off-Property resident and the child trespasser at the Property), exposed soil from 0-3 ft bgs is categorized as S-1 because the soil is currently accessible and the child's potential exposure is considered to be of high intensity. Exposed soil from 3-15 ft bgs is categorized as S-2. Soil deeper than 15 ft bgs, soil located beneath existing buildings, and soils located within the right-of-way is categorized as S-3 per 310 CMR 40.0933 (MassDEP, 2008a).

This Updated Revised Supplemental Risk Characterization assumes that the Property and all off-Property parcels may be developed for residential use in the future. Residents who may be present at the Site in the future under a residential use assumption will likely have high frequency with high intensity contact with soil. Based on potential exposures for the highest exposed receptor (resident), soil currently located from 0-15 ft bgs is categorized as S-1.

Groundwater underlying the Site meets none of the definitions of a Current or Potential Drinking Water Source Area and as such, is not categorized as GW-1. Groundwater at the Site containing COPCs that is within 30 feet of occupied buildings and less than 15 feet below grade meets the criteria for categorization as GW-2 as defined by 310 CMR 40.0933 (MassDEP, 2008a). Groundwater is categorized as GW-3 because, as provided in 310 CMR 40.0932, all groundwater of the Commonwealth is assumed to discharge to surface water and thus is categorized as GW-3.

5.3 Exposure Points

Exposure points (also called exposure areas) are defined as locations of potential contact between a receptor and portions/media of a property. The EPC is defined as the chemical concentration in a given medium which a potential receptor may encounter at an exposure point. As summarized in Section 3 of this Appendix, Site data were divided into six distinct exposure points: 1) Property, 2) 60 Tufts Street, 3) Tufts Street Area, 4) Alston Street Area, 5) Other Streets Area, and 6) Within Neighborhood Streets Area. The methods used to estimate EPCs within each exposure area are described in Section 5.6. The boundaries of each of these areas are depicted on Figure RC-1. Table RC-4 summarizes the soil, soil vapor, outdoor air, and groundwater samples considered in this Updated Revised Supplemental Risk

Characterization that were collected within each exposure area. Property and off-Property soil, groundwater, soil vapor, outdoor air, and indoor air data evaluated in this Risk Characterization are summarized in Attachment C.

5.3.1 Soil

It was assumed that the current receptors would be exposed to COPCs present in accessible surface soil (unpaved and located 0 to 3 ft bgs) within each of the six exposure areas delineated on Figure RC-1. Future residential and commercial receptors would be exposed to COPCs detected in soil located 0 to 15 ft bgs within each of the six exposure areas delineated on Figure RC-1.

The exposure point for future utility workers on the Property was defined as soil located between 0-6 ft bgs within the Property boundaries. The exposure point for future utility workers in the "Within Neighborhood Streets" exposure point was defined as soil located 0-6 ft bgs within all streets located within the Site boundaries.

The soil exposure point for the construction worker and other future receptors identified in Section 5.1 was defined as soil from 0-15 ft bgs located within each of the six exposure areas delineated on Figure RC-1.

5.3.2 Groundwater and Soil Vapor

Direct exposures to groundwater will only occur during utility activities at the Property and within the neighborhood streets. Monitoring wells that were quantitatively considered in this Updated Revised Supplemental Risk Characterization are listed in Table RC-4.

Soil vapor data were used to estimate ambient air concentrations within future construction and utility excavations/trenches. Soil vapor sampling locations that were quantitatively considered in this Updated Revised Supplemental Risk Characterization are listed in Table RC-4.

5.3.3 Indoor air

The Property building is comprised of a warehouse and garage, and a small portion is office space. To evaluate potential current exposures in the building as currently constructed, the building was divided into two exposure points: 1) The warehouse and garage and 2) The South and North Office area.

Consistent with prior Risk Characterizations, indoor air was considered an exposure point in the following commercial buildings: 163 Glen Street, 85 Washington Street, 91-95 Washington Street, 97 Washington Street, and 121 Washington Street. Indoor air data collected at these commercial properties are used to quantify indoor air exposures to current commercial workers

and potential future residents. Monitoring results show that no CVOCs were detected above reporting limits within the commercial building located at 142 Cross Street, so there is not a complete indoor air exposure pathway and no additional assessment is necessary at this location.

Indoor air was considered a current and future exposure point in the residences with a complete vapor intrusion exposure pathway. Refer to Section 5.1.2 for a summary of commercial and residential properties for which indoor air exposures were evaluated. Indoor air was not considered an exposure point within commercial and residential buildings where EPEMs have been implemented and the vapor intrusion pathway has been eliminated. It is assumed that EPEMs will continue to be maintained at these properties in accordance with a properly recorded AUL.

As discussed in Section 3.1.4 of this Report, detected concentrations of CVOCs within 30-40 Alston Street, 9 Knowlton Street, 16-20 Alston Street, 76 Franklin Street, 45-47 Tufts Street, and 51-51A Tufts Street are not attributable to the Site and were not evaluated in this Updated Revised Supplemental Risk Characterization.

GEI was refused access to collect sub-slab and/or indoor air sampling within the residential properties located at 12 Alston Street and 159 Glen Street. Therefore, insufficient data are currently available to determine potential exposures within these buildings.

GEI designed and oversaw the installation of an SSDS at the Capuano Center to mitigate migration of COPCs from beneath the floor slab into the indoor air. Results of monitoring following final installation of the SSDS and other EPEM measures consistently have been non-detect for CVOCs. Therefore, indoor air was not considered an exposure point for receptors at the Capuano Center in this Updated Revised Supplemental Risk Characterization. Response actions at the Capuano Center are summarized in Section 8 of the Phase II CSA.

5.3.4 “Hotspot” Evaluation

The MCP typically requires evaluation of exposures, as well as UCL comparisons in “hotspots”. The MCP (310 CMR 40.0006) defines a “hotspot” as an area where concentrations are more than 100-fold higher than the surrounding areas, except where the potential for greater exposure exists. At these latter sub-areas, concentrations more than 10-fold higher than surrounding concentrations might be “hotspots.” At this Site, no specific point or sub-area represents a location with higher potential for exposure than elsewhere. Inspection of the data does not indicate substantial variability. For the soil data “hotspot” reviews, the highest detected concentrations were compared to surrounding concentrations, while for the groundwater, and soil vapor data “hotspot” reviews, the highest temporally averaged concentrations were compared to temporally averaged surrounding concentrations. In no case was a maximum

concentration surrounded by concentrations more than 100-fold lower than the maximum. Therefore, no “hotspots” are present.

5.4 A Quantitative Evaluation of Potential Exposure Pathways

Exposure pathways are the mechanisms by which potential receptors may be exposed to COPCs at the Site. Individuals hypothetically exposed at high intensities and/or frequencies at each exposure point were quantitatively evaluated. Figure RC-2 summarizes the risk scenarios evaluated quantitatively in this Updated Revised Supplemental Risk Characterization.

5.5 Qualitative Evaluation of Potential Exposures

Quantitative evaluations based on hypothetical receptors with the greatest potential for exposure in each exposure point area result in conservative estimates for receptors conducting less intrusive roles on the Site. Specifically, trespassers, visitors, and railroad workers at the Site would have lower frequencies of exposure than a full-time commercial worker or a resident. Using the same rationale, the visitors, trespassers, and railroad workers in each exposure area were evaluated qualitatively via comparison to quantified exposures for the commercial and residential receptors. Similarly, current commercial workers within the Alston Street exposure area and current teachers at the Capuano Center (in the “Other Streets” exposure area) were evaluated qualitatively via comparison to quantified exposures for the residential receptors in the respective exposure areas. Landscapers and maintenance workers on the off-Property portions of the Site were also evaluated qualitatively via comparison to quantified construction worker exposures. Also, off-Property full-time indoor commercial workers were evaluated qualitatively via comparison to quantified indoor air exposures for the homebound residents. If “No Significant Risk” was demonstrated for the more highly exposed receptor, it was indicative of “No Significant Risk” to less exposed receptors.

5.6 Estimation of Exposure Point Concentrations

The EPC is defined as the chemical concentration in a given medium that a potential receptor may encounter at an exposure area. The following sections define EPCs for each exposure medium in each of the defined exposure areas of the Site (Figure RC-1). A summary of soil, groundwater, soil vapor, indoor air, and outdoor air EPCs used in this Updated Revised Supplemental Risk Characterization can be found in Table RC-6. Soil, groundwater, and soil vapor sample locations considered in this Updated Revised Supplemental Risk Characterization are summarized in Table RC-4; data used to determine the EPCs within each outdoor exposure point are summarized in the Tables 1(a-f) through 5(a-f) of Attachment C. Indoor air data used to determine the EPCs within each indoor exposure point are summarized in Attachment C of this Updated Revised Supplemental Risk Characterization. This Updated Revised Supplemental Risk Characterization performed a Worst Case assessment for exposures to off-Property soil, soil vapor, and groundwater. This was accomplished by designating the

maximum soil, soil vapor, and groundwater sample as the EPC for each COPC for each of the five off-Property exposure areas: 1) 60 Tufts Street Area, 2) Tufts Street Area, 3) Alston Street Area, 4) Other Streets Area, and 5) Within Neighborhood Streets Area (for utility worker receptors).

5.6.1 Soil

Soil EPCs were developed for each exposure area defined in Section 3.2 from the datasets described in Section 3.1. The arithmetic mean of measured concentrations within the Property exposure area was used as the EPC of each COPC for the identified receptors at the Property. The arithmetic means of the measurement data are representative of the true means for the exposure scenarios evaluated because a sufficient number of samples were collected to provide adequate horizontal and vertical coverage of the Site, and the data do not indicate a high level of variability. Additionally, no “hotspots” were identified. As is standard practice for human health risk assessments, the arithmetic mean of the measured concentrations was calculated assuming that non-detected compounds were present at one-half the laboratory reporting limit.

The soil EPCs for the remaining five off-Property exposure areas are defined as the maximum detected concentration of each COPC within each of the defined areas (Figure RC-1). If a COPC was not detected in a given exposure area, then one-half the lowest laboratory reporting limit was used as the EPC for that COPC.

5.6.2 Groundwater

Groundwater EPCs were developed for each exposure area where potential exposure may exist. To adequately represent seasonal influences on groundwater concentrations, the arithmetic mean of COPC concentrations detected was calculated for each monitoring well in each exposure area using recent rounds of groundwater samples (2006 to 2008), and the maximum calculated average was used as the EPC for the future construction and utility scenarios. The arithmetic mean of the measured concentrations was calculated assuming that non-detected compounds were present at one-half the laboratory reporting limit. If a COPC was not detected in a given exposure area, then one-half the lowest laboratory reporting limit was used as the EPC for that COPC.

Elevated laboratory reporting limits were reported for non-detect analytes in monitoring well MW-1 (located on the Property) during the April 2007 sampling event. The elevated reporting limits were the result of sample dilution required at the laboratory to meet instrument requirements. These elevated reporting limits were not used to calculate the arithmetic mean of the last four groundwater sampling rounds for monitoring well MW-1. It is important to note that concentrations actually detected in MW-1 during the April 2007 sampling event were included in the arithmetic mean.

5.6.3 Soil Vapor

Soil vapor EPCs were developed for each exposure area of the Site where potential exposure may exist. The arithmetic mean was calculated within each monitoring point of the last four rounds of soil vapor samples (2007 to 2008) and the maximum calculated average was the EPC of each COPC for the future construction and utility scenarios. The arithmetic mean of the measured concentrations was calculated assuming that non-detected compounds were present at one-half the laboratory reporting limit. If a COPC was not detected in a given exposure area, then one-half the lowest laboratory reporting limit was used as the EPC for that COPC.

5.6.4 Indoor Air

EPCs were developed for both of the current indoor air exposure points identified within the Property building: 1) the warehouse and garage and 2) the South and North Office area. The arithmetic mean of measured concentrations collected within each exposure point was used to represent the EPC of each COPC at the Property. The arithmetic mean of the measured concentrations was calculated assuming that non-detected compounds were present at one-half the laboratory reporting limit.

The indoor air EPCs for off-Property commercial and residential indoor air exposure points are the temporal average of the measured concentrations in indoor air, consistent with MassDEP and U.S. EPA guidance regarding averaging indoor air and other data in risk assessments. (MassDEP, 2002; MassDEP, 1995; U.S. EPA, 1989) Where indoor air data were not temporally representative (e.g., less than three sampling rounds), the maximum detected value was conservatively used as the EPC. If a COPC was not detected in a commercial or residential building, then one-half the lowest available laboratory reporting limit was used as the EPC for that COPC. Since indoor air samples were collected from both the basement and the first floor of some off-Property buildings, a time weighted average was calculated. The time-weighted average used to calculate the EPCs for the current commercial scenario at 97 Washington Street assumed that a worker spends 1 hour in the basement and the remaining 7 hours of the work day on the first floor. As requested by MassDEP in the NOAF/NON, the time-weighted average used to calculate the EPCs for the current and future residential scenarios conservatively assumes, in any instance where the basement has at least 7 feet of headroom, that a receptor spends 12 hours in the basement and 12 hours on the first floor, without regard to whether such an exposure assumption is consistent either with existing MassDEP guidance or actual site conditions. GEI has confirmed that the basements within the following 8 properties have less than 7 feet of headroom: 23 Knowlton Street, 95 Franklin Street, 99 Franklin Street, 10 Morton Street, 17 Knowlton Street, 18 Morton Street, 27 Tufts Street, and 4 Morton Street. Therefore, this Updated Risk characterization assumes that a residential receptor spends 4 hours in the basement and 20 hours on the first floor for these 8 properties. The basements with detected CVOCs are not currently used as living space, and evidence

suggests that these basements have not been used as living space since the buildings were constructed over 100 years ago. Considering the evidence of historic use of these basements, and current zoning and permitting requirements, it is unlikely that these basements will be converted to living space in the foreseeable future. As such, the assumption that receptors spend 12 hours per day in the basement is an overestimate of reasonably foreseeable exposures within these residences.

Indoor air samples have been routinely collected from two locations on the first floor of the commercial buildings located at 163 Glen Street and 121 Washington Street. The samples are collected within large open rooms in both commercial buildings. Therefore, the rooms were considered one exposure point, and an arithmetic average was calculated using both first floor samples collected on each given date. A temporal average was then calculated using these averages for available sample dates. Within the commercial property located at 85 Washington Street, indoor air samples have routinely been collected from two distinct locations (the auditorium and the parking garage). Therefore, a distinct temporal average was calculated for the auditorium exposure point and for the parking garage exposure point. The higher of these two temporal averages was used as the indoor air EPC for this property.

5.6.5 Ambient Air

Outdoor Air EPCs were developed for each of the six areas defined in section 3.1.6: 1) Property, 2) 60 Tufts Street, 3) Tufts Street Area, 4) Alston Street Area, 5) Other Streets Area, and 6) Within Neighborhood Streets. For each area, the arithmetic mean of measured concentrations in outdoor air was used to represent the EPC of each COPC for the identified receptors. The arithmetic mean of the measured concentrations was calculated assuming that non-detected compounds were present at one-half the laboratory reporting limit. If a COPC was not detected in outdoor air in a given exposure area, then one-half the lowest laboratory reporting limit was used as the EPC for that COPC.

To evaluate potential exposures to constituents that may volatilize from soil, soil vapor, and/or groundwater into the ambient air of an excavation or utility trench, EPCs for ambient air were estimated for use in the construction and utility scenarios. The concentrations for ambient air within an excavation or trench were predicted from each of the above-defined EPCs for soil, groundwater, and soil vapor. The average of the three predicted ambient air values was then retained as the EPC for ambient air for the construction worker and utility worker scenarios.

The vapor transport models used to estimate ambient air EPCs in the excavation/trench are based on a series of simple models that predict the concentrations of volatile compounds in ambient air as a result of migration from soil and groundwater sources using volatilization factors. Essentially the models assume partitioning from soil and groundwater into the vapor compartment of the vadose zone, followed by molecular diffusion to the soil surface. The flux of

vapor from the soil surface is then assumed to mix into a “box” of air above the source. Compounds in the box are cleared by ambient air movement, so that the equilibrium concentration in the box can be calculated when volatile flux is combined with wind-based removal. For the purposes of the present risk assessment, in which the “box” is a below-ground excavation, the models were modified slightly in the following ways:

1. The dimensions of the box were set at the assumed dimensions of an excavation or trench.
2. The source area for volatile flux was set at the dimensions of the surface of the excavation floor and sidewalls in the case of a soil source.
3. The source area for volatile flux from groundwater was set immediately below the excavation/trench floor.
4. The ambient windspeed was reduced to account for possible interference with the removal process caused by the subsurface nature of the excavation. No data are available for the relative reduction in ventilation that might be expected, so the value was set to one-half for the surface windspeed for the construction worker excavation scenario and one-tenth for the utility worker scenario.

A more detailed discussion of the models is provided in Attachment B to this report, and the predicted ambient air concentrations modeled from soil, groundwater, and soil vapor are shown in the models/risk calculations contained in Attachment A. Refer to Table RC-6 for the average of the three predicted ambient air values that was retained as the EPC for ambient air for the construction worker and utility worker scenarios. Physical properties used to model excavation and trench air EPCs for each COPC are summarized in Table RC-9.

5.7 Quantification of Potential Exposures

This section describes the equations and assumptions used to evaluate potential exposures to compounds detected at the property. These equations are consistent with equations presented by MassDEP (1995) and risk assessment guidance issued by the U.S. EPA (1989).

The Average Daily Dose (ADD) was calculated to estimate a receptor's potential daily intake from exposure to compounds with potential noncarcinogenic effects. According to MassDEP (1995) and U.S. EPA (1989), the exposure dose should be calculated by averaging over the period of time for which the receptor is assumed to be exposed. Subsequently, the ADD for each compound via each route of exposure was compared to the noncarcinogenic toxicity value (that is, the Reference Dose [RfD] or Reference Concentration [RfC]) for that compound in order to estimate the potential noncarcinogenic hazard index due to exposure to that compound via that route of exposure.

For compounds with potential carcinogenic effects, the lifetime average daily dose (LADD) was calculated to estimate potential exposures over the course of a lifetime (70 years). Subsequently, the LADD for each compound via each route of exposure was multiplied by the CSF or UR for that compound to estimate the potential carcinogenic risk due to exposure to that compound via that route of exposure.

The equations used to estimate ADDs and LADDs are presented below. The human exposure parameters used in each potential exposure pathway are presented in Table RC-7. The spreadsheets used to calculate ADD and LADD from these equations and parameter values are contained in Attachment A to this Appendix.

5.7.1 Soil

Exposure to soil was assumed to occur via incidental ingestion and dermal contact. ADDs and LADDs for soil ingestion were calculated as follows:

$$ADD_{ing} = \frac{C_{soil} \times IR_{soil} \times FI \times RAF_{os} \times CF \times EF \times EP}{AT \times BW}$$

where:

ADD _{ing}	=	Average Daily Dose Due to Ingestion (mg/kg-day)
LADD _{ing}	=	Lifetime Average Daily Dose Due to Ingestion (mg/kg/day)
C _{soil}	=	Compound Concentration in Soil (mg/kg)
IR _{soil}	=	Soil Ingestion Rate (mg/day)
FI	=	Fraction of Soil Ingested From the Site (unitless)
RAF _{os}	=	Relative Absorption Factor (Oral-Soil) (unitless)
CF	=	Conversion Factor (10 ⁻⁶ kg/mg)
EF	=	Exposure Frequency (days/year)
EP	=	Exposure Period (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (EP x 365 days/yr, ADD; 70yr x 365 days/yr, LADD)

ADDs and LADDs for dermal absorption were calculated as follows:

$$ADD_{der} \text{ or } LADD_{der} = \frac{C_{soil} \times SA \times AF \times RAF_{ds} \times CF \times EF \times EP}{AT \times BW}$$

where:

ADD _{der}	=	Average Daily Dose Due to Dermal Contact (mg/kg-day)
LADD _{der}	=	Lifetime Average Daily Dose Due to Dermal Contact (mg/kg/day)
C _{soil}	=	Compound Concentration in Soil (mg/kg)
SA	=	Skin Surface Area Exposed (cm ² /day)

AF	=	Soil to Skin Adherence Factor (mg/cm ²)
RAF _{ds}	=	Relative Absorption Factor (Dermal-Soil) (unitless)
CF	=	Conversion Factor (10 ⁻⁶ kg/mg)
EF	=	Exposure Frequency (days/year)
EP	=	Exposure Period (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (EP x 365 days/yr, ADD; 70yr x 365 days/yr, LADD)

The calculation of a LADD as opposed to an ADD is simply a matter of averaging time (AT).

5.7.2 Groundwater

Incidental groundwater exposure was also assumed to occur during utility work. The exposure equation is as follows:

$$ADD = \frac{CW \times (IR \times FI \times RAF_o + SA \times PC \times RAF_d) \times ED \times EF \times EP \times CF}{BW \times AP}$$

where:

ADD	=	Average Daily Dose Due to Ingestion and Dermal Contact (mg/kg-day)
LADD	=	Lifetime Average Daily Dose Due to Ingestion and Dermal Contact (mg/kg-day)
CW	=	Compound Concentration in Water (mg/L)
IR	=	Incidental Water Ingestion Rate (ml/hr)
FI	=	Fraction Ingested from Site (unitless)
RAF _o	=	Relative Absorption Factor (Oral-Water) (unitless)
SA	=	Skin Surface Area Exposed to groundwater (cm ² /hr)
PC	=	Skin Permeability (cm/hr) (these are compound-specific)
RAF _d	=	Relative Absorption Factor (Dermal-Water) (unitless)
ED	=	Exposure Duration (hr/day)
EF	=	Exposure Frequency (days/year)
EP	=	Exposure Period (years)
CF1	=	Conversion Factor (ml/cm ³)
CF2	=	Conversion Factor (L/ml)
BW	=	Body Weight (kg)
AP	=	Averaging Period (EP * 365 d/yr for noncancer; 70 yr * 365 d/yr for cancer)

5.7.3 Inhalation of Particulates

Inhalation of particulates (fugitive dust) was also evaluated. Exposure via inhalation of soil-derived fugitive dust is a function of the concentration at the source (e.g., soil), frequency and duration of contact, and a factor describing the concentration of compound in respirable particles in air.

MassDEP (2002a) considers that potential exposure via inhalation of dust occurs via two uptake pathways: uptake by the gastrointestinal (GI) tract following coughing up and subsequent

swallowing of particulates trapped by the mucosa of the upper respiratory track, and uptake by the respiratory system following inhalation into the lungs. To calculate the exposure associated with these two uptake pathways, MassDEP (2002a) assumes the following for the construction worker scenario (which was also conservatively used for other receptors):

1. 100% of respirable particulate mass (PM) is equal to or less than 30 microns in diameter ($\leq PM_{30}$)
2. 40% of total respiratory PM is equal to or less than 10 microns in diameter ($\leq PM_{10}$)
3. 100% of inhaled particulates greater than 10 microns but less than or equal to 30 microns are swallowed. 50% of inhaled particulates equal to or less than 10 microns are swallowed
4. 50% of inhaled particulates equal to or less than 10 microns enters the lungs.

Based on these assumptions, the effective exposure concentration of respirable particulates for the GI system is 2 times the concentration of PM10, while that for the lungs is 0.5 times the concentration of PM10. Using these effective exposure concentrations, Oil or Hazardous Material (OHM) average daily doses for the GI and respiratory systems can be estimated using the following equations.

ADD for the GI System ($ADD_{\text{inhalation-GI}}$):

$$ADD_{\text{inhalation-GI}} = \frac{[C_{\text{part}}] \times 2 \times [PM_{10}] \times IR_{\text{air}} \times RAF_i \times ET \times EF \times EP \times C}{BW \times AT}$$

where:

$ADD_{\text{inhalation-GI}}$	= Average Daily Dose due to coughing up and subsequent ingestion of inhaled particulates; expressed in mg/kg-day
$[C_{\text{part}}]$	= Concentration of OHM in airborne particulates
$[PM_{10}]$	= Concentration in air of particulates less than or equal to 10 microns in diameter
IR_{air}	= Inhalation rate for the receptor of concern during the period of exposure
RAF_i	= Relative Absorption Factor (inhalation)
ET	= Duration of each exposure event (hr/day)
EF	= Exposure frequency (days/year)
EP	= Duration of the exposure period (years)
C	= Appropriate unit conversion factor
BW	= Body weight of the receptor of concern during the averaging period
AT	= Averaging time

ADD for the Respiratory System ($ADD_{\text{inhalation}}$)

$$ADD_{\text{inhalation}} = \frac{[C_{\text{part}}] \times 0.5 \times [PM_{10}] \times IR_{\text{air}} \times RAF_i \times ET \times EF \times EP \times C}{BW \times AT}$$

where:

$ADD_{\text{inhalation}}$	=	Average Daily Dose Due to inhaled particulates entering the lungs (mg/kg-day)
$[C_{\text{part}}]$	=	Concentration of OHM in airborne particulates (mg/kg)
$[PM_{10}]$	=	Concentration in air of particulates less than 10 microns in diameter ($\mu\text{g}/\text{m}^3$)
IR_{air}	=	Inhalation rate (m^3/hr)
RAF_i	=	Relative Absorption Factor
ET	=	Duration of each exposure event (hr/day)
EF	=	Exposure frequency (days/yr)
EP	=	Duration of the exposure period (years)
C	=	Appropriate unit conversion factor ($10^{-9} \text{ kg}/\mu\text{g}$)
BW	=	Body weight (kg)
AT	=	Averaging time (d)

Dose-response values for inhalation exposure (i.e., unit risk and reference concentration) are expressed on a mass of compound per volume of air basis, using the assumption that a person weighs 70 kilograms (kg) and has a daily inhalation rate (Inh_{day}) of 20 cubic meters (m^3). Therefore, prior to the characterization of risk, $ADD_{\text{inhalation}}$ (mg/kg-day) for the compound must be converted to an average daily exposure ($ADE_{\text{inhalation}}$) (mg/m^3) in order to make it compatible with the corresponding dose-response values. This can be accomplished using the following equation:

$$ADE_{\text{inhalation}} = \frac{ADD_{\text{inhalation}} \times BW_{\text{assumed}}}{Inh_{\text{assumed}}}$$

where:

$ADE_{\text{inhalation}}$	=	Average daily oil/hazardous material concentration to which a receptor is exposed (mg/m^3)
$ADD_{\text{inhalation}}$	=	Average daily dose due to inhaled particulates entering the lungs (mg/kg-d)
BW_{assumed}	=	Body weight assumed in the development of RfCs and UR factors (70 kg)
Inh_{assumed}	=	Daily inhalation rate assumed in the development of RfCs and URFs ($20 \text{ m}^3/\text{d}$)

For the evaluation of the construction worker, landscaper, and outdoor worker, the concentration of PM10 in air was assumed to be $60 \mu\text{g}/\text{m}^3$ (MassDEP, 2002a). For other receptors, a PM10 concentration of $32 \mu\text{g}/\text{m}^3$ was used (MassDEP, 1995)

5.7.4 Inhalation of Indoor and Ambient Air

Inhalation exposures to ambient or indoor air are evaluated using RfCs and URs. These values represent a level of risk or hazard associated with hypothetically continuous exposure (i.e., 24 hours per day for a lifetime). Therefore, these toxicity factors must be used with an Average Daily Exposure (ADE) rather than an ADD as calculated for oral or dermal exposures. The ADE is simply the estimated exposure point concentration adjusted for non-continuous exposures:

$$ADE = C_{\text{air}} \times AF$$

where:

ADE = Average Daily Exposure ($\mu\text{g}/\text{m}^3\text{-day}$)
 C_{air} = Concentration of COPC in air
 AF = Adjustment Factor (unitless)

and where:

$$AF = \frac{ED \times EF \times EP}{24 \frac{\text{hr}}{\text{d}} \times 365 \frac{\text{d}}{\text{y}} \times AP}$$

where:

ED = exposure duration (hr/day)
 EF = exposure frequency (days/yr)
 EP = exposure period (years)
 AP = averaging period (years)

Exposure durations and frequencies are based on MassDEP (2008b) default values for construction workers and indoor workers.

As discussed above, this Updated Revised Supplemental Risk Characterization assumes that a homebound resident is exposed 365 days per year for 24 hours per day. This Updated Revised Supplemental Risk Characterization also evaluates exposure to a resident who is exposed to both indoor and outdoor exposure pathways. The exposure duration value used to evaluate the non-homebound resident receptor considers the following indoor exposure durations for each lifestage:

- Infant: 24 hours per day indoors for 365 days per year
- Young Child and Older Child: 20 hours per day indoors during summer months and 24 hours per day indoors during winter months

- Adult: 16 hours per day indoors during summer months and 24 hours per day indoors during winter months

The current and future resident receptor was evaluated assuming an exposure period of 30 years, except for the residence at 95 Franklin Street, where an EPEM modification was completed after February 14, 2011 to eliminate or further mitigate the indoor air pathway. This Updated Revised Supplemental Risk Characterization assumes an exposure duration of 5 years for 95 Franklin Street.

5.8 Relative Absorption Factors (RAFs)

The premise of calculating risk or hazard using toxicity data from laboratory experiments is that potential human exposure dose is similar to the administered dose or applied dose in the laboratory experiment. The animal-derived CSFs and RfDs used in quantitative risk assessment were based on applied doses in most cases. However, the efficiency of COPC absorption via a particular route and from a particular matrix (e.g., soil, water) at the Site may differ from the absorption efficiency for the exposure route and matrix used in the experimental study that serves as the basis for the CSF or RfD. RAFs are used to adjust the exposure dose based on these two absorption efficiencies. As recommended by MassDEP (1995) and U.S. EPA (1989), RAFs for COPCs were derived and used in the calculation of human exposure doses.

RAFs used in this Updated Revised Supplemental Risk Characterization are shown in Table RC-8. The RAFs were obtained from MassDEP (2008b). For COPCs that were not listed in MassDEP (2008b), RAFs were derived using standard approaches as used by MassDEP (2008b).

5.9 Dermal Permeability Constants

Dermal permeability constants are used in estimating potential dermal exposure to compounds in water. The dermal permeability constant values used in this Updated Revised Supplemental Risk Characterization were obtained from MassDEP (2008b) and are shown in Table RC-9.

6.0 Risk Characterization

Risk characterization includes estimates of the potential human health risks from exposure to noncarcinogens, both in the long term (chronic) and short term (acute). It also includes an assessment of the potential excess cancer risk from exposure to known and possible carcinogens.

Risk characterization is the step in the risk assessment process that combines the results of the exposure assessment and the dose-response assessment for each COPC in order to estimate the potential for noncarcinogenic and carcinogenic human health effects from exposure to that compound. This section summarizes the results of the Updated Revised Supplemental Risk Characterization for each receptor evaluated in this risk assessment. Estimated total noncarcinogenic and carcinogenic risks for each receptor in each exposure area are presented in Tables RC-10 through RC-35. Table RC-36 summarizes all risk estimates for the evaluated receptors in each exposure area. The risk calculations, which provide results for each receptor, exposure pathway, and COPC, are contained in Attachment A.

6.1 Noncarcinogenic Risk Characterization

The potential for exposures to COPCs identified at each exposure area to result in adverse noncarcinogenic health effects was estimated for each receptor by comparing the ADD for each compound with the RfD for that compound or by comparing the ADE to the RfC. The resulting ratio is known as the Hazard Quotient (HQ) for that compound. The HQ was calculated using the following formula:

$$HQ = \frac{ADD}{RfD}$$

where:

HQ = Hazard Quotient (unitless);
 ADD = Average Daily Dose (mg/kg-day); and
 RfD = Reference Dose (mg/kg-day) or RfC.

When an HQ for a given compound does not exceed 1, the RfD or RfC has not been exceeded, and no adverse noncarcinogenic health effects are expected to occur. The HQs for each compound were summed to yield the HI for that pathway. A total HI for a chemical was then calculated for each receptor by summing the pathway-specific HIs.

As shown in Tables RC-10 through RC-35 and summarized in Table RC-36, the total HIs for the evaluated scenarios are at or below MassDEP's target HI of 1. These results indicated that a

condition of “No Significant Risk” exists for non-cancer effects of current and future exposures at each exposure area.

6.2 Carcinogenic Risk Characterization

The purpose of carcinogenic risk characterization is to provide a conservative estimate of the likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of exposures to COPCs in various environmental media, assuming but not endorsing the premises established by regulatory authorities (e.g., use of animal studies to estimate carcinogenic potency based on a carcinogenic dose-response relationship that is linear at low doses). This likelihood is a function of the dose of a compound and the CSF for that compound. The relationship between the ELCR and the estimated LADD of a compound may be expressed as:

$$\text{ELCR} = 1 - e^{-\text{CSF} \times \text{LADD}}$$

where:

ELCR = Excess Lifetime Cancer Risk (unitless);
CSF = Cancer Slope Factor (1/(mg/kg-day)); and
LADD = Lifetime Average Daily Dose (mg/kg-day).

When the product of the CSF and the LADD is much greater than 1, the ELCR approaches 1 (*i.e.*, 100% probability). When the product is less than 0.01 (1×10^{-2}), the equation can be closely approximated by:

$$\text{ELCR} = \text{CSF} \times \text{LADD}$$

The product of the equation is unitless, and provides a conservative estimate of the potential carcinogenic risk associated with a receptor's exposure to that compound via that pathway. ELCRs are calculated for each potentially carcinogenic compound. For each receptor, the ELCRs for each pathway by which the receptor is assumed to be exposed is calculated by summing the potential risks derived for each compound. A Total ELCR is then calculated by summing the pathway-specific ELCRs.

Table RC-36 presents the total ELCRs calculated for the current and future receptors. Risk estimates for individual pathways are summarized in Tables RC-10 through RC-35. These results indicate that a condition of “No Significant Risk” exists for cancer effects for current and future exposures at each exposure area within the Site, with the exception of potential indoor air exposures at the 9 Tufts Street, 17 Tufts Street, and 19 Tufts Street residential properties, hypothetical future residential indoor air risks at the 91-95 Washington Street commercial

property, and potential cumulative indoor/outdoor risks to a future resident at 105-107 Washington Street¹. The ELCR calculations are based on conservative exposure durations and exposure point concentration assumptions. The owners of 9 Tufts Street, 17 Tufts Street, 19 Tufts Street, and 105-107 Washington have refused mitigation.

6.3 Applicable or Suitably Analogous Public Health Standards

The MCP at 310 CMR 40.0993 (3) requires an evaluation of Applicable and Suitably Analogous Standards (ASAS) in addition to quantitative risk assessment. The general list of ASAS provided in the MCP is the Massachusetts Drinking Water Quality Standards, the Massachusetts Air Quality Standards, and the Massachusetts Surface Water Quality Standards. Since groundwater at the Site is not categorized as GW-1, the Massachusetts Drinking Water Quality Standards do not apply.

The Massachusetts Air Quality Standards relate to ambient concentrations of the so-called “criteria pollutants” (sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead). Based on the nature of the release, no criteria pollutants are expected to be present at the Site or have been measured in air at the Site.

6.4 Risk to Safety and Public Welfare

In accordance with 310 CMR 40.0994, the risk of harm to safety and public welfare was evaluated. No overt situations posing a threat of physical harm or bodily injury exist, nor have persistent odors associated with the release been reported following IRA activities. As such, conditions at the Site do not pose a threat of physical harm or bodily injury, and present no dangerous or nuisance conditions.

As part of the public welfare evaluation, soil and groundwater EPCs across the Site were compared to UCLs. As indicated in Table RC-37, groundwater and soil EPCs are below the UCLs.

¹ Potential cumulative indoor/outdoor risks to a future resident at 105-107 Washington Street represent the sum of risks from the indoor air exposure pathway and the future outdoor exposure pathway within the “Other Streets” exposure area (See Table RC-31). The maximum detected analytes in soil were conservatively used to estimate worst-case outdoor risks within each of the off-Property exposure points (See Section 5.6.1). Actual future outdoor risks for the 105-107 Washington Street resident are lower than those reported in the result tables of this report. Exposure to indoor air alone, does not represent a condition of Significant Risk at 105-107 Washington Street.

6.5 Risk to the Environment

Risk to the Environment was evaluated in this Updated Revised Supplemental Risk Characterization in accordance with MassDEP guidance: Method 3 Environmental Risk Characterization (MassDEP, 1996) and 310 CMR 40.0000 (MassDEP, 2008a). This recent MassDEP guidance provides for two stages of environmental risk characterization:

- Stage I, which is used to identify those situations which require further evaluation; and
- Stage II, which is a detailed evaluation of those environmental exposure pathways identified in Stage I.

As part of Stage I, the available Site information is reviewed to identify the presence of environmental receptors and to determine whether the identified receptors are currently exposed, or could potentially be exposed, to Site-related COPCs. According to MassDEP guidance, a “complete exposure pathway means that the contamination is actually reaching plants or animals, or is likely to do so in the future” (MassDEP, 1996). Exposure pathways that are not complete, and are not likely to be complete, are not required to be evaluated further.

For terrestrial habitats, an evaluation of habitat quality was undertaken as the first step of the Stage I screening, in accordance with MassDEP guidance (1996). To evaluate terrestrial habitat quality, available information (including historical records, data collected within the Site, and field observations) was reviewed.

Based on a review of the MassDEP Priority Resource Map (PRM), there are no Natural Heritage and Endangered Species Program Estimated Habitats for Rare Wetland Wildlife within 500 feet of the Site. According to the Massachusetts Natural Heritage Atlas, there are no priority habitats or rare species, estimated habitats of rare wildlife, or certified vernal pools within 500 feet of the Site. As indicated in the Phase I Initial Site Investigation and Tier Classification Report dated June 16, 2006 and prepared by GEI, the Capuano Center property, located 350 feet east of the Property, is incorrectly shown on the MassDEP PRM as a Protected Open Space. There are no known Areas of Critical Environmental Concern (ACEC) located within 500 feet of the Site.

The Site is greater than two acres; however, areas within the Property and the off-Property portions of the Site are paved. Historical records, data collected within the Site, and field observations do not identify current or past visible physical evidence that OHM at or from the Site have come to be located in surface soil, surface water, sediment or wetlands. Specifically, no sheens from OHM, non-aqueous phase liquid (NAPL), oil, tar, or other solid or semi-solid hazardous materials have been observed in surface soil, surface water, sediments, or wetlands.

It is also important to note that concentrations of COPCs detected in currently accessible surface soil samples collected in 2008 by GEI are below the most stringent Method 1 Soil Standards (S-1/GW-2 and S-1/GW-3). Based on the low levels of COPCs in accessible surface soils and the scarcity of open land, the Site does not represent significant habitat or provide for exposures for potential terrestrial receptors. Due to the lack of exposure potential, no terrestrial exposure pathways were identified, and further evaluation of terrestrial habitat is not required (MassDEP, 1995).

For the Stage I screening of aquatic habitats, site information was again reviewed. The closest surface water body is the Mystic River, located approximately 1 mile northeast of the Site. Groundwater samples collected downgradient of the Site indicate concentrations of COPCs below Method 1 GW-3 Groundwater Standards, which are protective of potential surface water impacts. Based on the distance to the nearest surface water receptors and the current levels of COPCs in groundwater, the potential for the transport of COPCs in the groundwater to surface water and sediment receptors is not likely.

Based on the terrestrial and aquatic habitat evaluation, it is concluded that no "potentially significant exposures" to identified environmental receptors from COPCs likely exist, and a Stage II Environmental Risk Characterization is not necessary. Accordingly, conditions at the Site pose "No Significant Risk" to the Environment.

7.0 UNCERTAINTY ANALYSIS

Within any of the four steps of the risk assessment process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure that the health of local residents and the environment are protected. Therefore, when all of the assumptions are combined, it is much more likely that actual risks, if any, are over-estimated rather than under-estimated.

The assumptions that introduce the greatest amount of uncertainty in this risk assessment are discussed in this section. They are discussed in general terms, because for most of the assumptions there is not enough quantitative information to assign a numerical value that can be factored into the calculation of risk.

7.1 Hazard Identification

During the Hazard Identification step, compounds are selected for inclusion in the quantitative Risk Characterization. Detected compounds in Property soil, groundwater, and soil vapor were considered in the COPC screening evaluation. Therefore, because MCP protocols have been utilized for the several rounds of sampling and analytical methodologies conducted at the property, it is unlikely that exposures to these media are under-estimated by the hazard identification step.

7.2 Dose-Response Assessment

Dose-response values are usually based on limited toxicological data. For this reason, a margin of safety is built into estimates of both carcinogenic and noncarcinogenic risk, and actual risks may be lower than those estimated.

Human dose-response values are often extrapolated, or conservatively estimated, using the results of animal studies. Extrapolation from animals to humans introduces a great deal of uncertainty in the risk assessment because, in most instances, it is not known how differently a human may react to the chemical compared to the animal species used to test the compound. The procedures used to extrapolate from animals to humans involve conservative assumptions and incorporate several uncertainty factors (explicit factors for species extrapolation, and possible sensitive populations in the case of the RfD) that are more likely to over-estimate than under-estimate the no-effect dose in humans.

7.3 Exposure Assessment

During the exposure assessment, average daily doses of COPCs to which receptors are potentially exposed are calculated, which involves assumptions about how often exposure occurs. Such assumptions include location, accessibility, and use of an area. With this in mind, the receptor, or person who may potentially be exposed, and the location of exposure, were both defined for this Updated Revised Supplemental Risk Characterization. The locations where certain activities were assumed to take place have been purposely selected because chemical concentrations and frequency of exposure are expected to be high (i.e., use of the maximally affected areas). However, actual frequencies of exposure are likely to be much lower than assumed. In these cases, the person's potential exposure would be reduced, and the health risks discussed here would be overestimated.

Community gardens are located on the Capuano Center property within the Site boundaries on the corner of Franklin Street and Palmer Avenue. Soil samples collected from these gardens (Garden 1 and Garden 2 depicted on Figure 4-2 of the Phase II CSA) were included as part of the dataset defined for the "Other Streets" exposure area. No CVOCs were detected above laboratory reporting limits in either of these two shallow soil samples collected from the community garden. Because garden vegetables are rooted in shallow soil, no detailed assessment of the ingestion of garden vegetables was included in this Updated Revised Supplemental Risk Characterization. Based on results of Plant Headspace Screening conducted by MassDEP from the community gardens [three leaf samples (yellow leaf, grape leaf and Leanne's flowers) from the off-Site Oliver Street Garden and one leaf sample (mint leaf) from the on-Site Franklin Street Garden], MassDEP also concluded that "there is no indication that exposure to CVOCs is occurring through the use of the community gardens" (MassDEP, 2008c).

It was assumed that dewatering will occur prior to future construction activities and that direct contact with groundwater during construction will be minimal. Therefore, a construction worker's incidental ingestion and dermal contact with groundwater were not quantified in the Updated Revised Supplemental Risk Characterization. Contact with groundwater during construction projects will be limited to short-term dewatering activities. Exposures during these activities are likely to be equal to exposures quantified for a utility worker. In this Updated Revised Supplemental Risk Characterization, exposures for the utility worker receptor were evaluated within the Property and Neighborhood Streets exposure areas. Risk results indicate that utility worker risks are below the MassDEP acceptable levels in these areas.

As requested by MassDEP in the NOAF/NON, the time-weighted average used to calculate the EPCs for the current and future residential scenarios conservatively assumes, in any instance where the basement has at least 7 feet of headroom, that a receptor spends 12 hours in the

basement and 12 hours on the first floor. The basements with detected CVOCs are not currently used as living space, and evidence suggests that these basements have not been used as living space since the buildings were constructed over 100 years ago. Considering the evidence of historic use of these basements and current zoning and permitting requirements, it is unlikely that any of them will be converted to living space in the foreseeable future. As such, indoor air exposures presented within this Updated Revised Supplemental Method 3 Risk Characterization are an overestimate of likely exposures within these residences.

7.4 Risk Characterization

The risk of adverse human health effects depends on estimated levels of exposure and on dose-response relationships. Once exposure to and risk from each of the selected compounds is calculated, the total risk posed by exposure to soil is determined by combining the health risk contributed by each compound. Where COPCs do not interact, do not affect the same target organ or do not have the same mechanism of action, summing the risks for multiple COPCs results in an over-estimate of risk posed by the property. However, in order not to understate the risk, it is assumed that the effects of different compounds may be added together. While there does exist the theoretical possibility of greater than additive effects (synergism) among compounds with effects on the same target organ, the phenomenon of less than additive effects (antagonism) is well-recognized in the toxicology literature. Overall the application of the assumption of additivity provides a conservative estimate of health risks.

This Updated Revised Supplemental Risk Characterization was conducted using conservative assumptions. The arithmetic mean of soil concentrations was conservatively used to estimate risk for the identified receptors on the Property as per the MassDEP Risk Characterization guidance (MassDEP, 1995). The maximum detected analytes in soil and the maximum of temporally averaged soil vapor and groundwater data from all sample locations were conservatively used to estimate worst-case risks within each of the off-Property exposure points. Actual risks for all locations within each off-Property area, except in the vicinity of the specific sample locations where these maximum concentrations were detected, are lower than those reported in the result tables of this report.

Consistent with MassDEP's Indoor Air Sampling and Evaluation Guide (MassDEP, 2002), the indoor air EPCs for COPCs are defined in the Updated Revised Supplemental Risk Characterization as the temporal average concentrations when a robust data set was available for a residence (three rounds of samples with one round being taken during winter conditions) and the maximum concentrations when a robust data set was not available. This is a conservative approach to characterizing human health risk. Where available, results of sampling taken over the course of multiple seasons provide a representative range of potential exposures, and the average of those results provides a representative "time-integrated average concentration to which an inhabitant may be exposed over the longer term" (MassDEP, 2002).

In every case, this Updated Revised Supplemental Risk Characterization makes the conservative assumption that, contrary to any known instance at the Site, individuals are continuously exposed to measured concentrations every hour of every day of every year within the applicable exposure period, without ever leaving the Site.

8.0 Summary, Conclusions, and Recommendations

An Updated Revised Supplemental Method 3 Risk Characterization of potential harm to human health, public welfare, safety, and the environment for RTN 3-23246 was completed in accordance with the requirements of 310 CMR 40.0000 Subpart I of the Massachusetts Contingency Plan (MCP). In its NOAF/NON, MassDEP directed UniFirst Corporation to submit an “updated Risk Characterization . . . for all residences impacted by vapor intrusion.” For purposes of the “updated Risk Characterization,” MassDEP “recommend[ed] assuming an exposure duration of 12 hours in the basement or the bottom-most floor and 12 hours on upper floors” where the basement has at least 7 feet of headroom – notwithstanding MassDEP’s existing guidance to the contrary, and without regard to whether such exposure scenarios either are supported by observations concerning the current or likely future use of basement spaces, or are permitted by local zoning bylaws prohibiting such use in the future.

Without acknowledging and, in fact, expressly disclaiming any technical basis for MassDEP’s recommended approach, this Updated Revised Supplemental Risk Characterization was prepared using MassDEP’s recommended exposure duration of 12 hours in basements with at least 7 feet of headroom, regardless of existing or likely future use conditions for such basements. Indoor air data presented herein for each residence reflect additional data collection and EPEM modification measures completed by GEI as of February 14, 2011.

The Updated Revised Supplemental Risk Characterization evaluated potential risk to current and future receptors assumed to be exposed to constituents detected in soil, soil vapor, groundwater, and outdoor air. This Updated Revised Supplemental Risk Characterization also evaluated potential exposures to indoor air within affected Site buildings and residences. An exposure period of 30 years was used to evaluate current and potential future residential risks for all other buildings in which CVOCs have been detected, except for one residence where an EPEM was modified after February 14, 2011 to eliminate or further mitigate the indoor air pathway. Specifically, this Updated Revised Supplemental Risk Characterization assumes an exposure duration of 5 years for the residence at 95 Franklin Street and a 30-year exposure duration for all other evaluated residential exposures. The results of this Updated Revised Supplemental Risk Characterization demonstrate that the cancer and non-cancer risks associated with the evaluated exposures are at levels that constitute a condition of No Significant Risk as defined in the MCP, with the exception of indoor air risks estimated for the residences at 9 Tufts Street, 17 Tufts Street, and 19 Tufts Street, hypothetical future residential

indoor air risks at the 91-95 Washington Street commercial property, and cumulative indoor/outdoor risks to a future resident at 105-107 Washington Street. To date, the owners of 9 Tufts Street, 17 Tufts Street, 19 Tufts Street, and 105-107 Washington have refused mitigation.

This Updated Revised Supplemental Risk Characterization assumes that there is no complete indoor air pathway within the off-Property buildings (including the Capuano Center) with a current vapor mitigation system and non-detect post-mitigation samples. It is assumed that the vapor mitigation systems within these off-Property buildings and at the Property will remain in-place in accordance with a properly recorded AUL.

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FIGURE RC-1
EXPOSURE AREAS



LEGEND:

- MONITORING WELL WITH SOIL VAPOR SAMPLE PORT INSTALLED BY GEI, JANUARY 2007 - JANUARY 2008
- MONITORING WELL INSTALLED BY SANBORN HEAD ASSOCIATES, 2002
- MONITORING WELL INSTALLED BY GEOINSIGHT, JUNE 2004
- SOIL BORING ADVANCED BY GEOINSIGHT, AUGUST 2004
- MONITORING WELL INSTALLED BY GEI, MAY 2006
- DRIVEN POINT MONITORING WELL INSTALLED BY MADEP, MAY 2007
- MONITORING WELL INSTALLED PREVIOUSLY, DATE UNKNOWN
- PREVIOUSLY INSTALLED IRRIGATION WELL

CHAIN LINK FENCE

138 ROOM NUMBER AT CAPUANO SCHOOL

BOUNDARY OF COMMUNITY GARDENS

84 STREET ADDRESS

MBTA = MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

- DISPOSAL SITE BOUNDARY (DASHED WHERE INFERRED)
- NEIGHBORHOOD STREETS EXPOSURE AREA
- THE PROPERTY EXPOSURE AREA
- ALSTON STREET EXPOSURE AREA
- TUFTS STREET AREA AND RAILROAD EXPOSURE AREA
- 60 TUFTS STREET EXPOSURE AREA
- OTHER STREETS EXPOSURE AREA

NOTE: BASE PLAN COMPILED FROM PHASE II COMPREHENSIVE SITE ASSESSMENT BY GEI CONSULTANTS TITLED "DISPOSAL SITE MAP AND SITE BOUNDARY," FIG. 1-2.

0' 50' 100' 150' 200'
1" = 150'

CLIENT LOGO

CLIENT:

UNIFIRST CORPORATION
WILMINGTON, MASSACHUSETTS

DRAWN BY:
R. BOWMAN

CHECKED BY:
D. PFEIFFER

DATUM:
NAD 83

PROJECTION:
N/A

SCALE:
AS SHOWN

PROJECT

50 TUFTS STREET
SOMERVILLE, MASSACHUSETTS

TITLE

EXPOSURE AREAS

DATE:
19 MAY 2009

PROJECT NO:
7-6540-0000

REV. NO.:
A

FIGURE No.
RC-1

FIGURE RC-2

SUMMARY OF QUANTIFIED EXPOSURES

Figure RC-2
Summary of Quantified Exposures
50 Tufts Street, Somerville, MA
UniFirst Corporation

			Current					Future						
			Commercial Worker	Homebound Resident	Resident	Maintenance Worker / Landscaper	Student at Capuano Center	Utility Worker	Construction Worker	Commercial Worker	Homebound Resident	Resident	Maintenance Worker / Landscaper	Student at School
Exposure Point	Medium	Pathway												
Property	Soil	Ingestion	x			x		x	x	x		x	x	
		Dermal	x			x		x	x	x		x	x	
		Particulate Inhalation	x			x		x	x	x		x	x	
	Groundwater	Ingestion						x						
		Dermal						x						
	Ambient Air	Inhalation	x			x		x	x	x		x	x	
Indoor Air	Inhalation	x												
60 Tufts	Soil	Ingestion			x				x	x		x		
		Dermal			x				x	x		x		
		Particulate Inhalation			x				x	x		x		
	Groundwater	Ingestion												
		Dermal												
	Ambient Air	Inhalation			x				x	x		x		
Indoor Air	Inhalation													
Tufts Street Area	Soil	Ingestion			x				x	x		x		
		Dermal			x				x	x		x		
		Particulate Inhalation			x				x	x		x		
	Groundwater	Ingestion												
		Dermal												
	Ambient Air	Inhalation			x				x	x		x		
Indoor Air	Inhalation		x	x							x	x		
Alston Street Area	Soil	Ingestion			x				x	x		x		
		Dermal			x				x	x		x		
		Particulate Inhalation			x				x	x		x		
	Groundwater	Ingestion												
		Dermal												
	Ambient Air	Inhalation			x				x	x		x		
Indoor Air	Inhalation													
Other Streets Area	Soil	Ingestion	x		x		x		x	x		x		x
		Dermal	x		x		x		x	x		x		x
		Particulate Inhalation	x		x		x		x	x		x		x
	Groundwater	Ingestion												
		Dermal												
	Ambient Air	Inhalation	x		x		x		x	x		x		x
Indoor Air	Inhalation	x	x	x						x	x	x		
Neighborhood Streets	Soil	Ingestion						x						
		Dermal						x						
		Particulate Inhalation						x						
	Groundwater	Ingestion						x						
		Dermal						x						
	Ambient Air	Inhalation						x						
Indoor Air	Inhalation													

Notes:

Construction Worker and Utility exposures to Ambient Air occur within an excavation or trench

x = This exposure pathway was quantitatively evaluated in this Risk Characterization

Refer to text for a qualitative discussion of additional potential receptors

RISK CHARACTERIZATION TABLES

Table RC-1
Summary Statistics of All Soil, Groundwater, and Soil Vapor Data and Summary of Compounds of Potential Concern (COPC) Screening Process
50 Tufts Street, Somerville, MA
UniFirst Corporation

Analyte	Soil			Soil Vapor			Groundwater			COPC Screening
	Number of Detects	Number of Samples	Frequency of Detection	Number of Detects	Number of Samples	Frequency of Detection	Number of Detects	Number of Samples	Frequency of Detection	
Acetone							16	369	4%	a, b
Benzene	2	76	3%				17	369	5%	a
Bromodichloromethane							5	369	1%	b
Carbon disulfide							8	369	2%	a, b
Carbon tetrachloride				14	72	19%	7	396	2%	COPC (c)
Chlorobenzene							10	369	3%	a, b
Chloroethane				12	72	17%	15	396	4%	COPC (c)
Chloroform							41	369	11%	COPC (c)
Chloromethane							8	369	2%	b
Dichloroethane, 1,1-	5	92	5%	33	72	46%	201	396	51%	COPC
Dichloroethane, 1,2-				6	72	8%	8	396	2%	a
Dichloroethene, cis-1,2-	6	92	7%	19	72	26%	157	396	40%	COPC
Dichloroethene, 1,1-	3	92	3%	38	72	53%	201	396	51%	COPC
Ethylbenzene	2	76	3%				5	369	1%	a, b
Isopropyl benzene							1	369	0%	a, b
Methyl tert-butyl ether	2	76	3%				186	369	50%	a
Methylene chloride	3	75	4%				7	369	2%	b
Naphthalene	8	87	9%				8	368	2%	a
Propylbenzene, n-	1	75	1%				2	369	1%	b
Tetrachloroethane, 1,1,1,2-							11	368	3%	b
Tetrachloroethene	49	105	47%	68	72	94%	276	396	70%	COPC
Toluene	6	76	8%				32	369	9%	a
Trans-1,2-Dichloroethene				4	72	6%	34	396	9%	COPC
Trichloroethane, 1,1,1-	12	105	11%	54	72	75%	215	396	54%	COPC
Trichloroethane, 1,1,2-				1	72	1%	7	396	2%	b
Trichloroethene	22	105	21%	59	72	82%	265	396	67%	COPC
Trimethylbenzene, 1,2,4-	2	75	3%				8	369	2%	a, b
Trimethylbenzene, 1,3,5-	1	75	1%				4	369	1%	a, b
Vinyl chloride				14	72	19%	57	396	14%	COPC
Xylene, m,p-	3	76	4%				6	369	2%	a, b
Xylene, o-	3	76	4%				3	368	1%	a, b

Notes:
Blank cell indicates not applicable
a: Eliminated as a COPC because not related to site impacts
b: Eliminated as a COPC because was not analyzed or was detected at a very low (0-5%) frequency in all subsurface media
c: Eliminated as a COPC in indoor air because multiple lines of evidence indicate this analyte will not impact indoor air (discussed further in text)
Highlighted cell indicates the analyte is a COPC
Compounds listed in this table were detected at least once above the laboratory reporting limit in a soil, groundwater, and/or soil gas sample collected at the Property
Soil Frequency of Detection Statistics in this Table are based on soil data collected from 1/2002 through 3/11/2008, with the exception of disposal samples
Groundwater Frequency of Detection Statistics in this Table are based on groundwater data collected from 1/2007 through 7/2009.
Soil Gas Frequency of Detection Statistics in this Table are based on soil gas data collected from 1/2007 through 4/2009, with the exception of sub-slab vapor data.

Table RC-2
Summary Statistics of Indoor Air Data
50 Tufts Street, Somerville, MA
UniFirst Corporation

Analyte	Number of Detects	Number of Samples	Frequency of Detection
Acetone	0	2	0%
Butanone,2- (MEK)	0	1	0%
Carbon tetrachloride	311	434	85%
Chloroethane	1	124	2%
Chloroform	11	30	37%
Chloromethane	27	30	90%
Dichloroethane,1,1-	14	178	19%
Dichloroethane,1,2-	60	178	49%
Dichloroethene, cis-1,2-	8	172	11%
Dichloroethene,1,1-	10	174	14%
Methylene chloride	4	30	13%
Tetrachloroethene	283	427	82%
Toluene	0	1	0%
Trans-1,2-Dichloroethene	0	165	0%
Trichloroethane,1,1,1-	105	266	64%
Trichloroethane,1,1,2-	0	165	0%
Trichloroethene	72	231	54%
Vinyl chloride	0	165	0%

Notes:
Summary table includes all indoor air data collected within the Site boundaries
Duplicate samples are not included in statistics

Table RC-3
Summary Statistics of Outdoor Air Data
50 Tufts Street, Somerville, MA
UniFirst Corporation

Analyte	Number of Detects	Number of Samples	Frequency of Detection
Carbon tetrachloride	17	51	33%
Chloroethane	0	49	0%
Chloroform	0	6	0%
Chloromethane	8	8	100%
Dichloroethane, 1,1-	0	49	0%
Dichloroethane, 1,2-	0	49	0%
Dichloroethene, cis-1,2-	0	49	0%
Dichloroethene, 1,1-	0	49	0%
Methylene chloride	8	8	100%
Tetrachloroethene	24	52	46%
Trans-1,2-Dichloroethene	0	49	0%
Trichloroethane, 1,1,1-	11	51	22%
Trichloroethane, 1,1,2-	0	49	0%
Trichloroethene	7	50	14%
Vinyl chloride	0	49	0%

Notes:

Summary table includes all outdoor air data collected within the Study Area with the exception of influent and effluent data collected from systems operating on 50 Tufts and 150 Glen Street

Table RC-4
 Summary of Sample Locations within each Exposure Area
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Area	Medium	Sample Location
Property	Groundwater	GEO-1
Property	Groundwater	GEO-2
Property	Groundwater	MW104
Property	Groundwater	MW-1
Property	Groundwater	MW-3
Property	Groundwater	SH-MW1
Property	Groundwater	SH-MW2
Property	Groundwater	SH-MW3
Property	Groundwater	SH1
Property	Groundwater	SH3
Property	Groundwater	SH4
Property	Groundwater	MW-203
Property	Soil	50 TUFT-SOIL1
Property	Soil	50 TUFT-SOIL2
Property	Soil	50 TUFT-SOIL3
Property	Soil	50 TUFT-SOIL4
Property	Soil	50 TUFT-SOIL5
Property	Outdoor Air	50Tufts-North Parking Lot
Property	Outdoor Air	50Tufts-North Parking Lot 2
Property	Outdoor Air	50Tufts-South Parking Lot
60 Tufts Street	Groundwater	MW201
60 Tufts Street	Groundwater	MW202
60 Tufts Street	Soil	MW201
60 Tufts Street	Soil	MW202
60 Tufts Street	Soil vapor	MW201
60 Tufts Street	Soil vapor	MW202
60 Tufts Street	Outdoor Air	02 Tufts
60 Tufts Street	Outdoor Air	03 Tufts
Tufts Street Area	Groundwater	GEO-4
Tufts Street Area	Groundwater	GEO-5
Tufts Street Area	Groundwater	GEO-6
Tufts Street Area	Groundwater	MW109
Tufts Street Area	Soil	GEO-4
Tufts Street Area	Soil	27 Tufts
Tufts Street Area	Soil	MW109
Tufts Street Area	Soil vapor	MW109
Tufts Street Area	Outdoor Air	50Tufts-North Parking Lot
Tufts Street Area	Outdoor Air	50Tufts-North Parking Lot 2
Tufts Street Area	Outdoor Air	50Tufts-South Parking Lot
Tufts Street Area	Outdoor Air	O1 Tufts
Tufts Street Area	Outdoor Air	O2 Tufts
Tufts Street Area	Outdoor Air	O3 Tufts
Alston Street Area	Groundwater	MW114
Alston Street Area	Groundwater	MW115
Alston Street Area	Groundwater	MW105
Alston Street Area	Soil	10 Alston
Alston Street Area	Soil	MW115
Alston Street Area	Soil	MW114
Alston Street Area	Soil	MW105
Alston Street Area	Soil vapor	MW114
Alston Street Area	Soil vapor	MW115
Alston Street Area	Outdoor Air	04 Tufts

Notes:
 Table summarizes sample locations considered in the Risk Characterization
 See text for a summary of dataset selection decisions
 Boundaries of Exposure Areas are depicted in Figure RC-1

Table RC-4
Summary of Sample Locations within each Exposure Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Area	Medium	Sample Location
Other Streets Area	Groundwater	GEO-3
Other Streets Area	Groundwater	MW116
Other Streets Area	Groundwater	MW102
Other Streets Area	Groundwater	MW103
Other Streets Area	Groundwater	MW110
Other Streets Area	Groundwater	MW111
Other Streets Area	Groundwater	MW112A
Other Streets Area	Groundwater	MW118D
Other Streets Area	Groundwater	MW118S
Other Streets Area	Groundwater	MW118T
Other Streets Area	Groundwater	MW120D
Other Streets Area	Groundwater	MW120S
Other Streets Area	Groundwater	MW121D
Other Streets Area	Groundwater	MW121S
Other Streets Area	Groundwater	MW122
Other Streets Area	Groundwater	MW101
Other Streets Area	Groundwater	MW106
Other Streets Area	Soil	150 Glen Garden1
Other Streets Area	Soil	150 Glen Garden 2
Other Streets Area	Soil	163 Glen
Other Streets Area	Soil	19 Knowlton
Other Streets Area	Soil	29 Knowlton
Other Streets Area	Soil	35-37 Knowlt
Other Streets Area	Soil	74 Franklin
Other Streets Area	Soil	82 Franklin
Other Streets Area	Soil	MW106
Other Streets Area	Soil	MW110
Other Streets Area	Soil	MW111
Other Streets Area	Soil	MW112
Other Streets Area	Soil	MW112A
Other Streets Area	Soil	MW116
Other Streets Area	Soil	MW118D
Other Streets Area	Soil	MW120D
Other Streets Area	Soil	SB121A
Other Streets Area	Soil	BY 13 MORT
Other Streets Area	Soil	BY 4 MORT
Other Streets Area	Soil	MW101
Other Streets Area	Soil	MW102
Other Streets Area	Soil	MW103
Other Streets Area	Soil	MW121D
Other Streets Area	Soil	MW122
Other Streets Area	Soil	95R-FRONT
Other Streets Area	Soil	95R-BACK
Other Streets Area	Soil Subslab	95FRANK-NORTH FILL
Other Streets Area	Soil Subslab	95FRANK-NORTH SILT
Other Streets Area	Soil Subslab	95FRANK-SOUTH FILL
Other Streets Area	Soil Subslab	95FRANK-SOUTH SILT
Other Streets Area	Soil Subslab	95RFRANK-EASTFILL
Other Streets Area	Soil Subslab	95RFRANK-EASTSILT
Other Streets Area	Soil Subslab	95RFRANK-WESTFILL
Other Streets Area	Soil Subslab	95RFRANK-WESTSILT
Other Streets Area	Soil Subslab	95RSUBSOIL
Other Streets Area	Soil vapor	MW116
Other Streets Area	Soil vapor	MW106
Other Streets Area	Soil vapor	MW110
Other Streets Area	Soil vapor	MW111
Other Streets Area	Soil vapor	MW112
Other Streets Area	Soil vapor	MW112A
Other Streets Area	Soil vapor	MW118S
Other Streets Area	Soil vapor	MW120S
Other Streets Area	Soil vapor	MW121S
Other Streets Area	Soil vapor	MW122
Other Streets Area	Outdoor Air	150 Glen Roof
Other Streets Area	Outdoor Air	O1 150Glen
Other Streets Area	Outdoor Air	O2 150Glen
Other Streets Area	Outdoor Air	O5 Tufts
Other Streets Area	Outdoor Air	O6 Tufts

Notes:

Table summarizes sample locations considered in the Risk Characterization
See text for a summary of dataset selection decisions
Boundaries of Exposure Areas are depicted in Figure RC-1

Table RC-4
Summary of Sample Locations within each Exposure Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Area	Medium	Sample Location
Within Neighborhood Streets	Groundwater	MW114
Within Neighborhood Streets	Groundwater	MW115
Within Neighborhood Streets	Groundwater	MW102
Within Neighborhood Streets	Groundwater	MW103
Within Neighborhood Streets	Groundwater	MW105
Within Neighborhood Streets	Groundwater	MW110
Within Neighborhood Streets	Groundwater	MW111
Within Neighborhood Streets	Groundwater	MW112A
Within Neighborhood Streets	Groundwater	MW121D
Within Neighborhood Streets	Groundwater	MW121S
Within Neighborhood Streets	Groundwater	MW122
Within Neighborhood Streets	Groundwater	GEO-3
Within Neighborhood Streets	Groundwater	GEO-4
Within Neighborhood Streets	Groundwater	GEO-5
Within Neighborhood Streets	Groundwater	GEO-6
Within Neighborhood Streets	Soil	MW115
Within Neighborhood Streets	Soil	MW106
Within Neighborhood Streets	Soil	MW109
Within Neighborhood Streets	Soil	MW110
Within Neighborhood Streets	Soil	MW111
Within Neighborhood Streets	Soil	MW112
Within Neighborhood Streets	Soil	MW112A
Within Neighborhood Streets	Soil	MW114
Within Neighborhood Streets	Soil	SB121A
Within Neighborhood Streets	Soil	MW102
Within Neighborhood Streets	Soil	MW103
Within Neighborhood Streets	Soil	MW105
Within Neighborhood Streets	Soil	MW121D
Within Neighborhood Streets	Soil	MW122
Within Neighborhood Streets	Soil	GEO-4
Within Neighborhood Streets	Soil vapor	MW-106
Within Neighborhood Streets	Soil vapor	MW114
Within Neighborhood Streets	Soil vapor	MW115
Within Neighborhood Streets	Soil vapor	MW110
Within Neighborhood Streets	Soil vapor	MW111
Within Neighborhood Streets	Soil vapor	MW112
Within Neighborhood Streets	Soil vapor	MW112A
Within Neighborhood Streets	Soil vapor	MW121S
Within Neighborhood Streets	Soil vapor	MW122

Notes:
Table summarizes sample locations considered in the Risk Characterization
See text for a summary of dataset selection decisions
Boundaries of Exposure Areas are depicted in Figure RC-1

Table RC-5
Toxicity Information
50 Tufts Street, Somerville, MA
UniFirst Corporation

Compound	Reference Dose Oral Chronic Value (mg/kg-day)	Reference Dose Oral Subchronic Value (mg/kg-day)	Reference Concentration Inhalation Chronic Value (mg/m ³)	Reference Concentration Inhalation Subchronic Value (mg/m ³)	Cancer Slope Factor Oral Value (mg/kg-day) ⁻¹	Unit Risk Inhalation Value (ug/m ³) ⁻¹	Cancer Slope Factor Inhalation Value (mg/kg-day) ⁻¹
Carbon tetrachloride	0.0007	0.007	0.43	0.43	0.13	0.000015	0.0525
Chloroethane	0.4 ¹	0.4 ¹	10 ²	10 ²	NA	NA	NA
Chloroform	0.01	0.01	0.66	0.66	NA	0.000023	0.0805
Dichloroethane, 1,1-	0.1	1	0.5	5	NA	NA	NA
Dichloroethene, cis-1,2-	0.01	0.1	0.035	0.035	NA	NA	NA
Dichloroethene, 1,1-	0.05	0.05	0.2	0.2	NA	NA	1.2
Tetrachloroethene	0.01	0.1	4.6	4.6	0.051	0.00001	0.035
Trans-1,2-Dichloroethene	0.02	0.2	0.07	0.7	NA	NA	NA
Trichloroethane, 1,1,1-	0.09	0.9	5.2	5.2	NA	NA	NA
Trichloroethene	0.002	0.02	0.18	0.18	0.011	0.0000017	0.00595
Vinyl chloride	0.003	0.003	0.1	0.1	1.4	0.0000088	0.0308

Notes:

¹ Region 9 Preliminary Remediation Goals (<http://www.epa.gov/region09/waste/sfund/prg/index.html>)

² IRIS (<http://cfpub.epa.gov/ncea/iris/index.cfm>), checked on April 20, 2009.

All other values obtained from MassDEP (2008b,c)

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Commercial Worker, Potential Future Resident, Construction Worker, Utility Worker, and Landscaper at the Property											
Compound	Soil		Soil	Groundwater	Soil Vapor	Outdoor Air	Indoor Air	Indoor Air	Indoor Air	Temporal Average	
	Average 0-3'	Average 0-15'	Maximum of temporal averages	Maximum of temporal averages	Maximum of temporal averages	Average of 50 Tufts Street Data	Temporal Average Office	Temporal Average Warehouse and garage	Temporal Average Entire Building		
	mg/kg	mg/kg	mg/L	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3		
Carbon tetrachloride	4.7E-02	4.8E-02	1.4E-01	NA	NA	**	**	**	**		
Chloroethane	1.2E-01	1.2E-01	2.5E-01	NA	NA	**	**	**	**		
Chloroform	NA	NA	1.3E-01	NA	NA	**	**	**	**		
Dichloroethane, 1,1-	NA	NA	1.5E-01	NA	NA	4.1E-04	4.0E-04	4.0E-04	4.0E-04		
Dichloroethene, cis-1,2-	NA	NA	2.2E-01	NA	NA	4.0E-04	3.5E-04	3.5E-04	3.5E-04		
Dichloroethene, 1,1-	NA	NA	3.1E+00	NA	NA	4.0E-04	3.5E-04	3.5E-04	3.5E-04		
Tetrachloroethene	3.1E+00	1.1E+01	6.2E+01	NA	NA	5.5E-03	5.8E-03	7.7E-03	7.1E-03		
Trans-1,2-Dichloroethene	4.7E-02	4.8E-02	1.3E-01	NA	NA	4.0E-04	3.5E-04	3.5E-04	3.5E-04		
Trichloroethane, 1,1,1-	NA	NA	1.4E+02	NA	NA	8.8E-04	5.8E-04	6.4E-04	6.2E-04		
Trichloroethene	6.7E-02	6.4E-02	1.1E+02	NA	NA	6.9E-04	7.6E-04	8.6E-04	8.3E-04		
Vinyl chloride	4.7E-02	4.8E-02	1.3E-01	NA	NA	2.6E-04	2.5E-04	2.5E-04	2.5E-04		

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Residential Properties, Commercial Properties, and Construction workers on Alston Street						
	Worst case					
	Soil	Soil	Groundwater	Soil Vapor	Outdoor Air	
	Maximum 0-3' mg/kg	Maximum 0-15' mg/kg	Maximum of temporal averages mg/L	Maximum of temporal averages mg/m3	Sample "Tufts 04" mg/m3	
Compound						
Carbon tetrachloride	5.5E-02	4.5E-02	5.0E-04	3.2E-03	**	
Chloroethane	1.4E-01	1.1E-01	1.0E-03	1.4E-03	**	
Chloroform	5.5E-02	4.5E-02	5.0E-04	NA	**	
Dichloroethane, 1,1-	5.5E-02	4.5E-02	5.0E-04	1.0E-03	4.1E-04	
Dichloroethene, cis-1,2-	5.5E-02	4.5E-02	5.0E-04	9.0E-04	4.0E-04	
Dichloroethene, 1,1-	5.5E-02	4.5E-02	5.0E-04	1.0E-03	4.0E-04	
Tetrachloroethene	5.5E-02	4.5E-02	5.3E-04	2.2E-02	7.0E-04	
Trans-1,2-Dichloroethene	5.5E-02	4.5E-02	5.0E-04	9.0E-04	4.0E-04	
Trichloroethane, 1,1,1-	5.5E-02	4.5E-02	5.0E-04	1.7E-03	5.5E-04	
Trichloroethene	5.5E-02	4.5E-02	2.0E-03	2.9E-03	5.5E-04	
Vinyl chloride	5.5E-02	4.5E-02	5.0E-04	6.6E-04	2.6E-04	

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Residents and Commercial Properties, and Construction Workers on Tufts Street						
Compound	Worst case					Outdoor Air
	Soil	Soil	Groundwater	Soil Vapor		
			Maximum of temporal averages	Maximum of temporal averages		
	Maximum 0-3' mg/kg	Maximum 0-15' mg/kg	mg/L	mg/m3	mg/m3	
Carbon tetrachloride	8.0E-02	2.8E-02	5.0E-04	1.3E-02	**	
Chloroethane	2.0E-01	5.6E-02	1.0E-03	5.5E-03	**	
Chlbroform	NA	2.8E-02	5.0E-04	NA	**	
Dichloroethane, 1,1-	8.5E-02	2.8E-02	1.3E-02	8.0E-03	4.1E-04	
Dichloroethene, cis-1,2-	8.5E-02	2.8E-02	1.3E-02	8.0E-03	4.0E-04	
Dichloroethene, 1,1-	8.5E-02	2.8E-02	1.3E-02	8.0E-03	4.0E-04	
Tetrachloroethene	9.9E-02	3.2E-01	1.2E+01	8.8E+00	3.5E-03	
Trans-1,2-Dichloroethene	8.0E-02	2.8E-02	5.0E-04	8.0E-03	4.0E-04	
Trichloroethane, 1,1,1-	8.5E-02	8.0E-02	9.2E-02	3.3E-01	7.4E-04	
Trichloroethene	8.0E-02	2.8E-02	1.0E-01	3.2E-02	6.3E-04	
Vinyl chloride	8.0E-02	2.8E-02	5.0E-04	5.0E-03	2.6E-04	

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Residential Properties, Commercial Properties, and Construction on Other Streets						
Compound	Worst case					
	Soil	Soil	Groundwater	Soil Vapor	Outdoor Air	
	Maximum 0-3' mg/kg	Maximum 0-15' mg/kg	Maximum of temporal averages mg/L	Maximum of temporal averages mg/m3	mg/m3	
Carbon tetrachloride	4.9E-02	3.7E-02	5.0E-04	8.7E-01	**	
Chloroethane	1.2E-01	9.5E-02	1.5E-02	3.6E-01	**	
Chloroform	4.9E-02	3.7E-02	8.9E-03	NA	**	
Dichloroethane, 1,1-	1.3E-01	4.3E-01	7.7E-02	1.0E+00	4.7E-04	
Dichloroethene, cis-1,2-	4.9E-02	7.7E-01	2.0E-01	1.7E+00	4.6E-04	
Dichloroethene, 1,1-	4.9E-02	4.9E-01	4.3E-02	1.3E+00	4.6E-04	
Tetrachloroethene	9.9E-01	5.9E+01	6.7E+00	3.3E+02	8.2E-04	
Trans-1,2-Dichloroethene	4.9E-02	3.7E-02	7.6E-03	5.5E-01	4.6E-04	
Trichloroethane, 1,1,1-	7.7E-02	7.7E-02	9.1E-02	3.7E+00	6.4E-04	
Trichloroethene	3.6E-01	6.2E+00	1.5E-01	2.8E+00	6.4E-04	
Vinyl chloride	4.9E-02	3.7E-02	5.8E-02	3.5E-01	3.0E-04	

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Commercial Buildings and Potential Future Residents									
	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air
	Temporal Average 163 Glen St.	Temporal Average 85 Washington St.	Temporal Average 91-95 Washington Street	Spatial and Temporal Average Commercial Exposure**** 97 Washington St.	Spatial and Temporal Average Residential Exposure 97 Washington St.	Temporal Average 121 Washington St.			
Compound	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3			
Carbon tetrachloride	***	***	**	***	***	***			***
Chloroethane	***	***	**	***	***	***			***
Chloroform	***	***	**	***	***	***			***
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04			4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Tetrachloroethene	1.7E-03	1.0E-03	4.0E-03	1.4E-03	1.4E-03	1.3E-03			1.3E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Trichloroethane, 1,1,1-	7.6E-04	5.5E-04	5.5E-04	7.1E-04	7.8E-04	8.2E-04			8.2E-04
Trichloroethene	5.5E-04	5.5E-04	5.5E-04	5.5E-04	5.5E-04	5.5E-04			5.5E-04
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04			2.6E-04

NA=no data available for this compound in this medium
 ** =compound not a COPC for this medium
 ***=medium not evaluated
 +=assumes resident in basement for 4 hrs and first floor for 20hrs
 ****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Residential Properties, Commercial Properties, and Construction workers on 60 Tufts Street					
Compound	Worst case				
	Soil	Groundwater	Soil Vapor	Outdoor Air	
	Maximum 0-15' mg/kg	Maximum of temporal averages mg/L	Maximum of temporal averages mg/m3	Sample "Tufts 04" mg/m3	
Carbon tetrachloride	4.8E-02	5.0E-04	8.6E-03	**	
Chloroethane	1.2E-01	1.0E-03	4.1E-03	**	
Chloroform	NA	5.0E-04	NA	**	
Dichloroethane, 1,1-	4.8E-02	4.9E-04	1.1E-02	4.1E-04	
Dichloroethene, cis-1,2-	4.8E-02	5.0E-04	8.0E-03	4.0E-04	
Dichloroethene, 1,1-	4.8E-02	4.2E-03	1.3E-01	4.0E-04	
Tetrachloroethene	1.8E-01	2.9E-02	6.0E+00	1.4E-03	
Trans-1,2-Dichloroethene	4.8E-02	5.0E-04	5.5E-03	4.0E-04	
Trichloroethane, 1,1,1-	4.8E-02	1.8E-02	1.2E+00	6.2E-04	
Trichloroethene	3.4E-02	6.0E-03	1.2E+00	5.8E-04	
Vinyl chloride	4.8E-02	5.0E-04	3.6E-03	2.6E-04	

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

	EPCs: Utility Worker within Neighborhood Streets			
	Worst case			Maximum of temporal averages
	Soil	Groundwater	Soil Vapor	
	Maximum 0-6' mg/kg	Maximum of temporal averages mg/L		
Compound				mg/m3
Carbon tetrachloride	2.8E-02	5.0E-04		8.7E-01
Chloroethane	5.6E-02	1.0E-03		3.6E-01
Chloroform	2.8E-02	1.3E-02		NA
Dichloroethane, 1,1-	1.3E-01	4.9E-02		8.0E-01
Dichloroethene, cis-1,2-	2.8E-02	6.6E-02		5.5E-01
Dichloroethene, 1,1-	2.8E-02	2.9E-02		1.3E+00
Tetrachloroethene	9.9E-01	1.2E+01		3.3E+02
Trans-1,2-Dichloroethene	2.8E-02	1.3E-02		4.0E-04
Trichloroethane, 1,1,1-	7.7E-02	9.2E-02		3.7E+00
Trichloroethene	3.6E-01	1.4E-01		1.9E+00
Vinyl chloride	2.8E-02	1.3E-02		3.5E-01

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Residences									
	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air
	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average	Spatial and Temporal Average
	60 Tufts Street, #4	9 Tufts St. - Left Unit	9 Tufts St. - Right Unit	11-13 Tufts St.	17 Tufts St.	19 Tufts St.			
Compound	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3			
Carbon tetrachloride	**	**	**	**	**	**			**
Chloroethane	**	**	**	**	**	**			**
Chloroform	**	**	**	**	**	**			**
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04			4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Tetrachloroethene	1.8E-03	1.7E-03	4.1E-03	1.4E-03	3.5E-03	4.1E-03			4.1E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04			4.0E-04
Trichloroethane, 1,1,1-	5.5E-04	5.5E-04	5.5E-04	5.7E-04	5.5E-04	5.5E-04			5.5E-04
Trichloroethene	8.6E-04	5.5E-04	5.5E-04	5.5E-04	1.4E-03	1.7E-03			1.7E-03
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04			2.6E-04

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Residences						
Compound	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air
	Spatial and Temporal Average 23 Tufts Street	Spatial and Temporal Average 25 Tufts St.	Spatial and Temporal Average+ 27 Tufts St.	Spatial and Temporal Average 49 Tufts St.	Spatial and Temporal Average 162-164 Glen St.	
	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	
Carbon tetrachloride	**	**	**	**	***	***
Chloroethane	**	**	**	**	***	***
Chloroform	**	**	**	**	***	***
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Tetrachloroethene	8.4E-04	2.6E-03	9.8E-04	1.0E-03	1.6E-03	1.6E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Trichloroethane, 1,1,1-	5.5E-04	5.5E-04	5.5E-04	5.4E-04	5.5E-04	5.5E-04
Trichloroethene	5.5E-04	5.5E-04	5.5E-04	6.0E-04	5.5E-04	5.5E-04
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Residences						
Compound	Indoor Air		Indoor Air		Indoor Air	
	Spatial and Temporal Average 6-8 Morton St.	Spatial and Temporal Average+ 10 Morton Street	Spatial and Temporal Average 12 Morton Street	Spatial and Temporal Average+ 18 Morton Street	Spatial and Temporal Average 19-19A Morton \Street	
	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	
Carbon tetrachloride	**	**	**	**	**	**
Chloroethane	**	**	**	**	**	**
Chloroform	**	**	**	**	**	**
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Tetrachloroethene	1.5E-03	7.0E-04	7.7E-04	2.8E-03	1.8E-03	1.8E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Trichloroethane, 1,1,1-	5.5E-04	5.5E-04	5.5E-04	5.5E-04	5.5E-04	5.5E-04
Trichloroethene	5.5E-04	2.5E-03	5.5E-04	1.5E-03	5.5E-04	5.5E-04
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Residences						
	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air	Indoor Air
	Spatial and Temporal Average	Spatial and Temporal Average+	Spatial and Temporal Average ⁺	Spatially Weighted Average using Maximum Detects ⁺	Spatial and Temporal Average	Spatially and Temporal Average ⁺
	12-14 Knowlton St.	17 Knowlton St.	23 Knowlton St.	95 Franklin Street	97 Franklin Street	99 Franklin St.
Compound	mg/m3	mg/m2	mg/m3	mg/m3	mg/m3	mg/m3
Carbon tetrachloride	**	**	**	**	**	**
Chloroethane	**	**	**	**	**	**
Chloroform	**	**	**	**	**	**
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Tetrachloroethene	1.0E-03	8.5E-01	1.8E-03	1.7E-02	9.2E-04	2.4E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Trichloroethane, 1,1,1-	5.5E-04	5.5E-04	6.9E-04	5.5E-04	5.5E-04	5.5E-04
Trichloroethene	5.5E-04	5.5E-04	6.0E-04	6.1E-04	5.5E-04	5.5E-04
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04	2.6E-04

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-6
Summary of Exposure Point Concentrations
50 Tufts Street
Somerville, MA

EPCs: Indoor Air Current Residences				
Compound	Indoor Air		Indoor Air	
	Spatial and Temporal Average 105-107 Washington Street	Spatially and Temporal Average 111 Washington Street	Spatial and Temporal Average 4 Morton Street	
	mg/m3	mg/m3	mg/m3	mg/m3
Carbon tetrachloride	**	**	**	**
Chloroethane	**	**	**	**
Chloroform	**	**	**	**
Dichloroethane, 1,1-	4.1E-04	4.1E-04	4.1E-04	4.1E-04
Dichloroethene, cis-1,2-	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Dichloroethene, 1,1-	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Tetrachloroethene	3.0E-03	1.0E-03	1.8E-03	1.8E-03
Trans-1,2-Dichloroethene	4.0E-04	4.0E-04	4.0E-04	4.0E-04
Trichloroethane, 1,1,1-	5.5E-04	5.5E-04	5.5E-04	5.5E-04
Trichloroethene	5.5E-04	5.5E-04	5.5E-04	5.5E-04
Vinyl chloride	2.6E-04	2.6E-04	2.6E-04	2.6E-04

NA=no data available for this compound in this medium
** =compound not a COPC for this medium
***=medium not evaluated
+=assumes resident in basement for 4 hrs and first floor for 20hrs
****=assumes worker in basement for 1hr and first floor for 7hrs

Table RC-7
Exposure Assumptions
50 Tufts Street, Somerville, MA
UniFirst Corporation

Medium	Route	Parameter	Units	Resident Infant	Resident Young Child	Resident Older Child	Resident Adult	Resident TWA	Value	Source	Comment	Homebound Resident	Value	Source	Comment
Soil	Incidental Ingestion & Dermal Contact	Soil Ingestion Rate	mg/d	NE	100	50	50	64	a	b		NE	NE		
		Soil TWA Ingestion Rate	mg-y/kg-d												
		Soil Dermal Contact Skin Exposed	cm ² /d	NE	2431	4427	5653	659	a	b	Median values for face, hands, forearms, lower legs, and feet of females	NE	NE		
		Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-cm ²												
		Soil Dermal Contact Adherence Rate	mg/cm ²	NE	0.35	0.14	0.13	0.35	a			NE			
		Soil Exposure Frequency	d/y	NE	150	150	150	150	a			NE			
		Soil Exposure Period - Cancer	y	NE	7	7	16	30	a			NE			
		Soil Exposure Period - Non-Cancer	y	NE	7	7	16	7	a			NE			
		Soil Averaging Time - Cancer	d	NE	25550	25550	25550	25550	a			NE			
		Soil Averaging Time - Non-Cancer	d	NE	2555	2555	5840	2555	a			NE			
Groundwater	Ingestion & Dermal Contact	Groundwater Ingestion Rate	L/d	NE	NE	NE	NE	NE				NE			
		Groundwater TWA Ingestion Rate	L-y/kg-d												
		Groundwater Exposure Frequency	d/y	NE	NE	NE	NE	NE				NE			
		Groundwater Exposure Period - Cancer	y	NE	NE	NE	NE	NE				NE			
		Groundwater Exposure Period - Non-Cancer	y	NE	NE	NE	NE	NE				NE			
		Groundwater Averaging Time - Cancer	d	NE	NE	NE	NE	NE				NE			
		Groundwater Averaging Time - Non-Cancer	d	NE	NE	NE	NE	NE				NE			
		Groundwater Dermal Contact Skin Exposed	cm ²	NE	NE	NE	NE	NE				NE			
		Groundwater TWA Dermal Contact Skin Exposed	cm ² -y/kg	NE	NE	NE	NE	NE				NE			
		Groundwater Dermal Contact Exposure Time	hr/d	NE	NE	NE	NE	NE				NE			
Outdoor Air	Inhalation of Volatiles	Outdoor Air Exposure Time - Volatiles	hr/d	NE	4	4	8	6	d		Takes into account indoor exposures	NE			
		Outdoor Air Exposure Frequency - Volatiles	d/y	NE	150	150	150	150	e			NE			
		Outdoor Air Exposure Period - Cancer - Volatiles	y	1	7	7	15	30	a			NE			
		Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	7	7	15	7	a			NE			
		Outdoor Air Averaging Time - Cancer - Volatiles	d	NE	25550	25550	25550	25550	a			NE			
		Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	NE	2555	2555	5475	2555	a			NE			
Outdoor Air	Inhalation of Particulates	Outdoor Air Inhalation Rate - Particulates	m ³ /hr	NE	0.4	0.7	1		c		Light exertion	NE			
		Outdoor Air TWA Inhalation Rate - Particulates	m ³ -y/h-kg	NE				0.5	b			NE			
		Outdoor Air PM10 - Particulates	ug/m ³	NE	32	32	32	32	f			NE			
		Outdoor Air Exposure Time - Particulates	hr/d	NE	4	4	8	6	d		Takes into account indoor exposures	NE			
		Outdoor Air Exposure Frequency - Particulates	d/y	NE	150	150	150	150	e			NE			
		Outdoor Air Exposure Period - Cancer - Particulates	y	1	7	7	15	30	a			NE			
		Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	7	7	15	7	a			NE			
		Outdoor Air Averaging Time - Cancer - Particulates	d	NE	25550	25550	25550	25550	a			NE			
		Outdoor Air Averaging Time - Non-Cancer - Particulates	d	365	2555	2555	5475	2555	a			NE			
Indoor Air	Inhalation of Volatiles	Indoor Air Exposure Time	h/d	24	20 / 24	20 / 24	16 / 24		d		takes into account outdoor exposure 150d/y	24	d		100% indoors; No outdoor exposure
		Indoor Air Exposure Frequency	d/y	365	215 / 150	215 / 150	215 / 150		d		takes into account outdoor exposure 150d/y	365	d		
		Indoor Air Exposure Period - Cancer	y	1	7	7	15		a			30	a		
		Indoor Air Exposure Period - Non-Cancer	y	1	7	7	15		a			7	a		
		Indoor Air Averaging Time - Cancer	d	365	25550	25550	25550		a			25550	a		
		Indoor Air Averaging Time - Non-Cancer	d	365	2555	2555	5475		a			2555	a		
General		Body Weight	kg		17	40	59		a						

NE - No exposure via this route
a - MADEP (2008). available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm>
b - Time-weighted average calculated using the following formula:
c - MADEP (1995a). Appendices to the Guidance for Disposal Site Risk Characterization - In support of the Massachusetts Contingency Plan. Interim Final Policy. WSC/ORS-95-141. July, 1995.
d - Professional judgement
e - Value for soil exposure
f - MADEP (2007). Technical Update: Calculation of Risks due to Inhalation of Particulates by Construction Workers. Office of Research and Standards. Available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm> Revised January 2007.
g - Value for construction worker

$$CR_{TWA} = \frac{CR_{YC} \times EP_{YC}}{BW_{YC}} + \frac{CR_{OC} \times EP_{OC}}{BW_{OC}} + \frac{CR_A \times EP_A}{BW_A}$$

where :

CR = Contact Rate
EP = Exposure Period
BW = Body Weight
TWA = Time - Weighted Average
YC = Young Child
OC = Older Child
A = Adult

Medium	Route	Parameter	Units	Commercial / Industrial Worker (Outdoor/Indoor)			Commercial / Industrial Worker (Indoor Only)			Construction Worker		
				Value	Source	Comment	Value	Source	Comment	Value	Source	Comment
Soil	Incidental Ingestion & Dermal Contact	Soil Ingestion Rate	mg/d	50	a		NE	a		100	a	
		Soil TWA Ingestion Rate	mg-y/kg-d									
		Soil Dermal Contact Skin Exposed	cm ² /d	3473	a	Median value for face, hands, forearms, and feet of females	NE	a	Median value for face, hands, forearms, and feet of females	3473	a	Median value for face, hands, forearms, and feet of females
		Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-cm ²									
		Soil Dermal Contact Adherence Rate	mg/cm ²	0.03	a		NE	a		0.29	a	
		Soil Exposure Frequency	d/y	120	a		NE	a		130	a	
		Soil Exposure Period - Cancer	y	27	a		NE	a		1	a	
		Soil Exposure Period - Non-Cancer	y	27	a		NE	a		1	a	
		Soil Averaging Time - Cancer	d	25550	a		NE	a		25550	a	
		Soil Averaging Time - Non-Cancer	d	9855	a		NE	a		182	a	
Groundwater	Ingestion & Dermal Contact	Groundwater Ingestion Rate	L/d	NE			NE			NE	d	
		Groundwater TWA Ingestion Rate	L-y/kg-d							NE		
		Groundwater Exposure Frequency	d/y	NE			NE			NE	d	
		Groundwater Exposure Period - Cancer	y	NE			NE			NE	a	
		Groundwater Exposure Period - Non-Cancer	y							NE	a	
		Groundwater Averaging Time - Cancer	d	NE			NE			NE	a	
		Groundwater Averaging Time - Non-Cancer	d	NE			NE			NE	a	
		Groundwater Dermal Contact Skin Exposed	cm ²	NE			NE			NE	a	
		Groundwater TWA Dermal Contact Skin Exposed	cm ² -y/kg									
		Groundwater Dermal Contact Exposure Time	hr/d	NE			NE			NE	d	
Outdoor Air	Inhalation of Volatiles	Outdoor Air Exposure Time - Volatiles	hr/d	4	d	Takes into account indoor exposure	NE	d		8	d	
		Outdoor Air Exposure Frequency - Volatiles	d/y	120	e		NE	e		130	d	
		Outdoor Air Exposure Period - Cancer - Volatiles	y	27	a		NE	a		1	a	
		Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	a		NE	a		1	a	
		Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	a		NE	a		25550	a	
		Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	a		NE	a		182	a	
Outdoor Air	Inhalation of Particulates	Outdoor Air Inhalation Rate - Particulates	m ³ /hr	1	c	Light exertion	NE	c		4	a	Heavy exertion
		Outdoor Air TWA Inhalation Rate - Particulates	m ³ -y/h-kg				NE					
		Outdoor Air PM10 - Particulates	ug/m ³	32	f		NE	f		60	f	
		Outdoor Air Exposure Time - Particulates	hr/d	4	d	Takes into account indoor exposure	NE	d		8	d	
		Outdoor Air Exposure Frequency - Particulates	d/y	120	a		NE	a		130	d	
		Outdoor Air Exposure Period - Cancer - Particulates	y	27	a		NE	a		1	a	
		Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	a		NE	a		1	a	
		Outdoor Air Averaging Time - Cancer - Particulates	d	25550	a		NE	a		25550	a	
		Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	a		NE	a		182	a	
Indoor Air	Inhalation of Volatiles	Indoor Air Exposure Time	h/d	4 / 8	d	Takes into account outdoor exposure for 120 d/year	8	d		NE		
						Total of 250 days; Takes into account outdoor exposure for 120 d/year						
		Indoor Air Exposure Frequency	d/y	120 / 130	d		250	d		NE		
		Indoor Air Exposure Period - Cancer	y	27	a		27	a		NE		
		Indoor Air Exposure Period - Non-Cancer	y	27	a		27	a		NE		
		Indoor Air Averaging Time - Cancer	d	25550	a		25550	a		NE		
		Indoor Air Averaging Time - Non-Cancer	d	9855	a		9855	a		NE		
General		Body Weight	kg	61	a		61	a		58	a	

NE - No exposure via this route
a - MADEP (2008). available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm>
b - Time-weighted average calculated using the following formula:
c - MADEP (1995a). Appendices to the Guidance for Disposal Site Risk Characterization - In support of the Massachusetts Contingency Plan. Interim Final Policy. WSC/ORS-95-141. July, 1995.
d - Professional judgement
e - Value for soil exposure
f - MADEP (2007). Technical Update: Calculation of Risks due to Inhalation of Particulates by Construction Workers. Office of Research and Standards. Available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm> Revised January 2007.
g - Value for construction worker

Table RC-7
Exposure Assumptions
50 Tufts Street, Somerville, MA
UniFirst Corporation

Medium	Route	Parameter	Units	Utility Worker			Student Young Child			Landscaper		
				Value	Source	Comment	Source		Comment	Value	Source	Comment
Soil	Incidental Ingestion & Dermal Contact	Soil Ingestion Rate	mg/d	100	g		100	a		100	a	
		Soil TWA Ingestion Rate	mg-y/kg-d					b				
		Soil Dermal Contact Skin Exposed	cm ² /d	3473	g	Median value for face, hands, forearms, and feet of females	2495	-	Median values for face, hands, forearms, lower legs, and feet of females	3473	a	Median value for face, hands, forearms, and feet of females
		Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-cm ²					a				
		Soil Dermal Contact Adherence Rate	mg/cm ²	0.29	g		0.35	a		0.19	a	
		Soil Exposure Frequency	d/y	1	d		208	a		30	a	1 day/week; April through October
		Soil Exposure Period - Cancer	y	5	d		2	a		27	a	
		Soil Exposure Period - Non-Cancer	y	5	d		2	a		27	a	
		Soil Averaging Time - Cancer	d	25550	d		25550	a		25550	a	
		Soil Averaging Time - Non-Cancer	d	1825	d		2555	a		9855	a	
Groundwater	Ingestion & Dermal Contact	Groundwater Ingestion Rate	L/d	0.01	d		NE			NE		
		Groundwater TWA Ingestion Rate	L-y/kg-d				NE					
		Groundwater Exposure Frequency	d/y	1	d		NE			NE		
		Groundwater Exposure Period - Cancer	y	5	d		NE			NE		
		Groundwater Exposure Period - Non-Cancer	y	5	d		NE			NE		
		Groundwater Averaging Time - Cancer	d	25550	d		NE			NE		
		Groundwater Averaging Time - Non-Cancer	d	1825	d		NE			NE		
		Groundwater Dermal Contact Skin Exposed	cm ²	817	g	Median value for hands of females	NE			NE		
		Groundwater TWA Dermal Contact Skin Exposed	cm ² -y/kg				NE					
		Groundwater Dermal Contact Exposure Time	hr/d	2	d		NE			NE		
Outdoor Air	Inhalation of Volatiles	Outdoor Air Exposure Time - Volatiles	hr/d	8	d		8	d		8	d	
		Outdoor Air Exposure Frequency - Volatiles	d/y	1	d		208	e		30	e	1 day/week; April through October
		Outdoor Air Exposure Period - Cancer - Volatiles	y	5	d		2	a		27	a	
		Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	d		2	a		27	a	
		Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	d		25550	a		25550	a	
		Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	d		2555	a		9855	a	
Outdoor Air	Inhalation of Particulates	Outdoor Air Inhalation Rate - Particulates	m ³ /hr	4	g	Heavy exertion	0.4	c	Light exertion	4	c	Heavy exertion
		Outdoor Air TWA Inhalation Rate - Particulates	m ³ -y/h-kg					b				
		Outdoor Air PM10 - Particulates	ug/m ³	60	g		32	f		60	f	
		Outdoor Air Exposure Time - Particulates	hr/d	8	d		8	d		8	d	
		Outdoor Air Exposure Frequency - Particulates	d/y	1	d		208	e		30.4	a	
		Outdoor Air Exposure Period - Cancer - Particulates	y	5	d		2	a		27	a	
		Outdoor Air Exposure Period - Non-Cancer - Particulates	y	5	d		2	a		27	a	
		Outdoor Air Averaging Time - Cancer - Particulates	d	25550	d		25550	a		25550	a	
		Outdoor Air Averaging Time - Non-Cancer - Particulates	d	1825	d		2555	a		9855	a	
Indoor Air	Inhalation of Volatiles	Indoor Air Exposure Time	h/d	NE			NE	d		NE	d	
		Indoor Air Exposure Frequency	d/y	NE			NE	d		NE	d	
		Indoor Air Exposure Period - Cancer	y	NE			NE	a		NE	a	
		Indoor Air Exposure Period - Non-Cancer	y	NE			NE	a		NE	a	
		Indoor Air Averaging Time - Cancer	d	NE			NE	a		NE	a	
		Indoor Air Averaging Time - Non-Cancer	d	NE			NE	a		NE	a	
General		Body Weight	kg	58	g		16	a		58	a	

NE - No exposure via this route
a - MADEP (2008). available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm>
b - Time-weighted average calculated using the following formula:
c - MADEP (1995a). Appendices to the Guidance for Disposal Site Risk Characterization - In support of the Massachusetts Contingency Plan. Interim Final Policy. WSC/ORS-95-141. July, 1995.
d - Professional judgement
e - Value for soil exposure
f - MADEP (2007). Technical Update: Calculation of Risks due to Inhalation of Particulates by Construction Workers. Office of Research and Standards. Available from <http://www.mass.gov/dep/service/compliance/riskasmt.htm> Revised January 2007.
g - Value for construction worker

Table RC-8
Relative Absorption Factors
50 Tufts Street, Somerville, MA
UniFirst Corporation

Compound	Relative Absorption Factor Soil Ingestion Non- Cancer Chronic	Relative Absorption Factor Soil Dermal Non- Cancer Chronic	Relative Absorption Factor Soil Ingestion Non- Cancer Subchronic	Relative Absorption Factor Soil Dermal Non- Cancer Subchronic	Relative Absorption Factor Soil Ingestion Cancer	Relative Absorption Factor Soil Dermal Cancer	Relative Absorption Factor Water Ingestion Non- Cancer Subchronic	Relative Absorption Factor Water Ingestion Non- Cancer Chronic	Relative Absorption Factor Water Ingestion Cancer	Relative Absorption Factor Water Dermal Cancer	Relative Absorption Factor Water Dermal Non- Cancer Chronic	Relative Absorption Factor Water Dermal Non- Cancer Subchronic	Relative Absorption Factor Air Inhalation Cancer	Relative Absorption Factor Air Inhalation Non- Cancer Chronic	Relative Absorption Factor Air Inhalation Non- Cancer Subchronic
Carbon tetrachloride	1	0.1	1	0.1	1	0.1	1	1	1	1	1	1	1	1	1
Chloroethane	1	0.1	1	0.1	NC	NC	1	1	NC	NC	1	1	NC	1	1
Chloroform	1	0.1	1	0.1	NA	NA	1	1	NC	NC	1	1	1	1	1
Dichloroethane,1,1-	1.3	0.13	1.3	0.13	NC	NC	1.3	1.3	NC	NC	1	1	NC	1	1
Dichloroethene, cis-1,2-	1	0.1	1	0.1	NC	NC	1	1	NC	NC	1	1	NC	1	1
Dichloroethene,1,1-	1	0.1	1	0.1	NC	NC	1	1	NC	NC	1	1	1	1	1
Tetrachloroethene	1	0.1	1	0.1	1	0.1	1	1	1	1	1	1	1	1	1
Trans-1,2-Dichloroethene	1	0.1	1	0.1	NC	NC	1	1	NC	NC	1	1	NC	1	1
Trichloroethane,1,1,1-	1	0.1	1	0.1	NC	NC	1	1	NC	NC	1	1	NC	1	1
Trichloroethene	1	0.1	1	0.1	1	0.1	1	1	1	1	1	1	1	1	1
Vinyl chloride	1	0.1	1	0.1	1.5	0.16	1	1	1.5	1	1	1	1	1	1

Notes:
NC - Not calculated
Values obtained from MassDEP.

Table RC-9
Chemical/Physical Properties
50 Tufts Street, Somerville, MA
UniFirst Corporation

Compound	S		H		H'		MW		VP		logK _{ow}		K _{oc}		MP		C _{sat}		K _p	
	Solubility (ug/L)	Solubility (ug/L) Source	Henry's Law Constant (atm- m ³ /mole)	Henry's Law Constant (atm- m ³ /mole) Source	Henry's Law Constant (dimensionless) Source	Henry's Law Constant (dimensionless) Source	Molecular Weight (g/mole)	Molecular Weight (g/mole) Source	Vapor Pressure (mm Hg)	Vapor Pressure (mm Hg) Source	Log(Octanol- Water Partition Coefficient (cm ³ /g))	Log(Octanol- Water Partition Coefficient (cm ³ /g)) Source	Organic Carbon- Water Partition Coefficient (cm ³ /g)	Organic Carbon- Water Partition Coefficient (cm ³ /g) Source	Melting Point (degrees C)	Melting Point (degrees C) Source	Soil Saturation Concentration (mg/kg)	Soil Saturation Concentration (mg/kg) Source	Dermal Permeability Constant (cm/hr)	Dermal Permeability Constant (cm/hr) Source
Carbon tetrachloride	7.93E+05	1	2.76E-02	1	1E+00	1	154	2	113	7	2.83	4	1.5E+02	5	-23	3	9.70E+02	7	1.6E-02	1
Chloroethane	6.71E+06	1	1.11E-02	1	4E-01	7	64.52	7	1010	1	1.43	7	2.4E+01	7	-138.7	7	1.50E+03	7	6.1E-03	7
Chloroform	7.95E+06	1	3.67E-03	1	2E-01	1	119	2	160	7	1.97	4	5.3E+01	5	-63.6	3	3.52E+03	7	6.8E-03	1
Dichloroethane, 1,1-	5.04E+06	1	5.62E-03	1	2E-01	1	99	2	234	7	1.79	4	5.3E+01	5	-96.9	3	2.34E+03	7	6.7E-03	1
Dichloroethene, cis-1,2-	6.41E+06	1	4.08E-03	1	2E-01	1	97	2	202	7	1.76	3	3.6E+01	5a	-80	3	2.21E+03	7	6.6E-03	6
Dichloroethene, 1,1-	2.42E+06	1	2.61E-02	1	1E+00	1	97	2	591	7	1.48	4	6.5E+01	5	-122.5	3	1.67E+03	7	4.3E-03	1
Tetrachloroethene	2.06E+05	1	1.77E-02	1	7E-01	1	166	2	19	7	3.4	4	2.7E+02	5	-22.3	3	3.76E+02	7	3.3E-02	1
Trans-1,2-Dichloroethene	4.52E+06	1	9.38E-03	1	4E-01	1	97	2	331	7	2.09	4	3.8E+01	5	-49.8	3	1.81E+03	7	1.1E-02	1
Trichloroethane, 1,1,1-	1.29E+06	1	1.72E-02	1	7E-01	1	133	2	100	7	2.49	4	1.4E+02	5	-30.4	3	1.34E+03	7	1.3E-02	1
Trichloroethene	1.28E+06	1	9.85E-03	1	4E-01	1	131	2	77	7	2.42	4	9.4E+01	5	-84.7	3	9.49E+02	7	1.2E-02	1
Vinyl chloride	8.80E+06	1	2.78E-02	1	1E+00	1	63	2	2580	7	1.62	4	1.9E+01	5a	-153.7	3	3.73E+03	7	8.2E-03	1

Notes:
1 Syracuse Research Corporation (<http://www.syrres.com/esc/physdemo.htm>)
2 ATSDR, "Toxicological Profile for _____"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.
3 US EPA Soil Screening Guidance: Technical Background Document, EPA/540/R95/128, May 1996
4 OSHA Documentation of TLV -TWA
5 Measured Koc from the SSL Guidance, Table 39
5a Calculated Koc from the SSL Guidance, Table 39
6 <http://chemfinder.cambridgesoft.com>
7 Risk Assessment Information System (RAIS), <http://rais.onml.gov/>

Table RC-9
Chemical/Physical Propertles
50 Tufts Street, Somerville, MA
UniFirst Corporation

Compound	D _a		D _w		t _H		BP		t _{crit}		ΔH _{v,b}		ΔH _{v,TS}	H _{TS}	H' _{TS}	D ^{eff} _{VA}	D ^{eff} _{VB}	D ^{eff} _{VT}	D ^{eff} _{crack}	D ^{eff} _{cz}	D ^{eff} _T	SDF
	Diffusivity	Diffusivity	Diffusivity	Diffusivity	Henry's Law	Henry's Law	Normal	Normal	Critical	Critical	Enthalpy of	Enthalpy of	Enthalpy of	Henry's Law	Henry's Law	Effective	Effective	Effective	Effective	Effective	Effective	Source
	In Air	In Air	In Water	In Water	Constant	Constant	Bolling	Bolling	Temperature	Temperature	Vaporization	Vaporization	Vaporization	Constant at	Constant at	Diffusivity In	Diffusivity In	Diffusivity	Diffusivity	Diffusivity	Diffusivity	Dilution
	(cm ² /sec)	(cm ² /sec)	(cm ² /sec)	(cm ² /sec)	Reference	Reference	Point	Point	(degrees K)	(degrees K)	at Normal	at Normal	at Avg GW	Avg GW Temp	Avg GW Temp	Vadose Zone	Vadose Zone	In Vadose	In Crack	in Capillary	Total	Factor
		Source		Source	Temperature	Temperature	(degrees K)	(degrees K)	Source	Source	Boiling Point	Boiling Point	Temp	(atm-m ³ /mol)	(conc/conc)	Layer A (adj	Layer B	Zone Total	in Crack	Zone	(cm ² /sec)	(unitless)
Carbon tetrachloride	7.80E-02	7	8.80E-06	7	25	7	349.9	7	556.6	7	7127	7	7859	1.37E-02	5.88E-01	1.54E-02	1.54E-02	1.54E-02	1.54E-02	1.32E-03	5.69E-03	1
Chloroethane	2.71E-01	7	1.15E-05	7	24	7	285.45	7	460.15	7	24.65	7	25	1.11E-02	4.77E-01	5.35E-02	5.35E-02	5.35E-02	5.35E-02	4.57E-03	1.98E-02	1
Chloroform	1.04E-01	7	1.00E-05	7	25	7	334.32	7	536.4	7	6988	7	7554	1.87E-03	8.04E-02	2.05E-02	2.05E-02	2.05E-02	2.05E-02	1.76E-03	7.60E-03	1
Dichloroethane,1,1-	7.42E-02	7	1.05E-05	7	25	7	330.55	7	523	7	6895	7	7450	2.89E-03	1.24E-01	1.46E-02	1.46E-02	1.46E-02	1.46E-02	1.26E-03	5.42E-03	1
Dichloroethene, cis-1,2-	7.36E-02	7	1.13E-05	7	25	7	333.65	7	544	7	7192	7	7734	2.04E-03	8.79E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.25E-03	5.39E-03	1
Dichloroethene,1,1-	9.00E-02	7	1.04E-05	7	25	7	304.75	7	576.05	7	6247	7	6392	1.47E-02	6.34E-01	1.78E-02	1.78E-02	1.78E-02	1.78E-02	1.52E-03	6.56E-03	1
Tetrachloroethene	7.20E-02	7	8.20E-06	7	25	7	394.4	7	620.2	7	8288	7	9553	7.53E-03	3.24E-01	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.21E-03	5.25E-03	1
Trans-1,2-Dichloroethene	7.07E-02	7	1.19E-05	7	25	7	320.85	7	516.5	7	6717	7	7136	4.96E-03	2.13E-01	1.40E-02	1.40E-02	1.40E-02	1.40E-02	1.19E-03	5.16E-03	1
Trichloroethane,1,1,1-	7.80E-02	7	8.80E-06	7	25	7	347.24	7	545	7	7136	7	7885	8.50E-03	3.66E-01	1.54E-02	1.54E-02	1.54E-02	1.54E-02	1.32E-03	5.69E-03	1
Trichloroethene	7.90E-02	7	9.10E-06	7	25	7	360.36	7	544.2	7	7505	7	8557	4.58E-03	1.97E-01	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.33E-03	5.77E-03	1
Vinyl chloride	1.06E-01	7	1.23E-06	7	25	7	259.25	7	432	7	5250	7	5000	1.78E-02	7.65E-01	2.09E-02	2.09E-02	2.09E-02	2.09E-02	1.79E-03	7.73E-03	1

- Notes:
- 1 Syracuse Research Corporation (<http://www.syrres.com/esc/physdemo.htm>)
 - 2 ATSDR, "Toxicological Profile for _____"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.
 - 3 US EPA Soil Screening Guidance: Technical Background Document, EPA/540/R95/128, May 1996
 - 4 OSHA Documentation of TLV -TWA
 - 5 Measured Koc from the SSL Guidance, Table 39
 - 5a Calculated Koc from the SSL Guidance, Table 39
 - 6 <http://chemfinder.cambridgesoft.com>
 - 7 Risk Assessment Information System (RAIS), <http://rais.oml.gov/>

Table RC-10
 Risk Summary
 Current Exposures: Commercial Worker at The Property
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways for Indoor/Outdoor Commercial Worker		
Soil ingestion and dermal	1E-04	3E-08
Soil particulate	5E-07	1E-10
Ambient Air (outdoor data)	2E-03	1E-06
Cumulative Risk without Indoor Air	2E-03	1E-06
Indoor Air Inhalation Pathway for Indoor/Outdoor Commercial Worker		
Office space	5E-03	5E-06
Warehouse and garage	4E-03	4E-06
Indoor Air Inhalation Pathway for Full-time Indoor Commercial Worker		
Office space	6E-03	7E-06
Warehouse and garage	6E-03	5E-06
Cumulative Outdoor and Indoor Pathways for Indoor/Outdoor Commercial Worker		
Average of 50 Tufts Outdoor Air (office average)	6E-03	7E-06
Average of 50 Tufts Outdoor Air (warehouse and garage average)	6E-03	5E-06

Table RC-11
 Risk Summary
 Current Exposures: Landscaper at The Property
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	1E-05	2E-08
Soil particulate	2E-07	4E-10
Ambient Air (outdoor data)	6E-04	6E-07
Cumulative Risk	6E-04	7E-07

Table RC-12
Risk Summary
Future Exposures: Future Resident at The Property
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	5E-03	5E-07
Soil particulate	2E-06	1E-09
Ambient Air (Outdoor data)	2E-03	3E-06
Cumulative Risk	7E-03	3E-06

Table RC-13
Risk Summary
Future Exposures: Commercial Worker at The Property
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	4E-04	8E-08
Soil particulate	2E-06	4E-10
Ambient Air (outdoor data)	2E-03	1E-06
Cumulative Risk	2E-03	1E-06

Table RC-14
Risk Summary
Future Exposures: Landscaper at The Property
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	3E-05	6E-08
Soil particulate	5E-07	1E-09
Ambient Air (outdoor data)	6E-04	6E-07
Cumulative Risk	6E-04	7E-07

Table RC-15
 Risk Summary
 Future Exposures: Construction Worker at The Property
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	3E-04	1E-08
Soil particulate	5E-06	2E-10
Excavation Air (average of ambient air values predicted from soil, groundwater and soil vapor data)	6E-01	1E-05
Cumulative Risk	6E-01	1E-05

Table RC-16
 Risk Summary
 Future Exposures: Utility Worker at The Property
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	1E-06	5E-10
Soil particulate	2E-08	7E-12
Groundwater ingestion and dermal	1E-02	8E-07
Trench Air (average of ambient air values predicted from soil, groundwater and soil vapor data)	1E-02	1E-06
Cumulative Risk	2E-02	2E-06

Table RC-17
Risk Summary
Current and Future Exposures: Resident at 60 Tufts Street
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	6E-04	9E-08
Soil particulate	2E-07	1E-10
Ambient Air (outdoor data)	2E-03	7E-07
Cumulative Outdoor Risk	2E-03	8E-07
Resident Indoor Air Risks for each property		
60 Tufts Street, Unit 4 ^{1,2}	3E-02	8E-06
Homebound Resident Indoor Air Risks for each property		
60 Tufts Street, Unit 4 ^{1,2}	3E-02	9E-06
Resident Cumulative Indoor and Outdoor Pathways		
60 Tufts Street, Unit 4	3E-02	9E-06

Notes:

Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures

Homebound Resident assumes exposure only to indoor pathways

¹Temporal average concentrations were used to calculate indoor air risks.

²Assumes 30 year exposure.

Table RC-18
 Risk Summary
 Future Exposures: Commercial Worker at 60 Tufts Street
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	4E-05	1E-08
Soil particulate	2E-07	4E-11
Ambient Air (outdoor air)	1E-03	4E-07
Cumulative Risk	1E-03	4E-07

Table RC-19
Risk Summary
Future Exposures: Construction Worker at 60 Tufts Street
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	7E-05	2E-09
Soil particulate	1E-06	2E-11
Excavation Air (average of soil, groundwater and soil vapor)	3E-04	9E-09
Cumulative Risk	4E-04	1E-08

Table RC-20
Risk Summary
Indoor Air Risks
Current Exposures: Resident in Alston Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	7E-04	1E-07
Soil particulate	3E-07	1E-10
Ambient Air (outdoor data)	2E-03	4E-07
Cumulative Outdoor Risk	2E-03	5E-07

Notes:
Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures

Table RC-21
Risk Summary
Indoor Air Risks
Future Exposures: Resident in Alston Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	5E-04	8E-08
Soil particulate	2E-07	1E-10
Ambient Air (outdoor data)	2E-03	4E-07
Cumulative Outdoor Risks	2E-03	5E-07

Notes:
Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures

Table RC-22
Risk Summary
Future Exposures: Commercial Worker in Alston Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	4E-05	1E-08
Soil particulate	2E-07	4E-11
Ambient Air (outdoor air)	1E-03	2E-07
Cumulative Outdoor Risk	1E-03	2E-07

Table RC-23

Risk Summary

Future Exposures: Construction Worker in Alston Street Area

50 Tufts Street, Somerville, MA

UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	8E-05	2E-09
Soil particulate	1E-06	2E-11
Excavation Air (average of soil, groundwater and soil vapor)	2E-04	3E-09
Cumulative Risk	3E-04	5E-09

Table RC-24
Risk Summary
Indoor Air Risks
Current Exposures: Resident in Tufts Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	9E-04	1E-07
Soil particulate	4E-07	2E-10
Ambient Air (outdoor air)	2E-03	2E-06
Cumulative Outdoor Risk	3E-03	2E-06
Resident Indoor Air Risks for each property		
9 Tufts Street - Left Unit ^{2,3}	2E-02	8E-06
9 Tufts Street - Right Unit ^{2,3}	2E-02	2E-05
11-13 Tufts Street ^{2,3}	2E-02	7E-06
17 Tufts Street ^{2,3}	3E-02	2E-05
19 Tufts Street ^{2,3}	3E-02	2E-05
23 Tufts Street ^{2,3}	2E-02	4E-06
25 Tufts Street ^{2,3}	2E-02	1E-05
27 Tufts Street ^{2,3}	2E-02	5E-06
Homebound Resident Indoor Air Risks for each property		
9 Tufts Street - Left Unit ^{2,3}	3E-02	9E-06
9 Tufts Street - Right Unit ^{2,3}	3E-02	2E-05
11-13 Tufts Street ^{2,3}	3E-02	7E-06
17 Tufts Street ^{2,3}	3E-02	2E-05
19 Tufts Street ^{2,3}	3E-02	2E-05
23 Tufts Street ^{2,3}	3E-02	5E-06
25 Tufts Street ^{2,3}	3E-02	1E-05
27 Tufts Street ^{2,3}	3E-02	5E-06
Resident Cumulative Indoor and Outdoor Pathways		
9 Tufts Street - Left Unit	3E-02	1E-05
9 Tufts Street - Right Unit	3E-02	2E-05
11-13 Tufts Street	3E-02	8E-06
17 Tufts Street	3E-02	2E-05
19 Tufts Street	3E-02	2E-05
23 Tufts Street	3E-02	6E-06
25 Tufts Street	3E-02	1E-05
27 Tufts Street	3E-02	7E-06

Notes:

Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures

Homebound Resident assumes exposure only to indoor pathways

¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.

²Temporal average concentrations were used to calculate indoor air risks.

³Assumes 30 year exposure.

Table RC-25
Risk Summary
Indoor Air Risks
Future Exposures: Resident in Tufts Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	5E-04	6E-08
Soil particulate	2E-07	8E-11
Ambient Air (outdoor air)	2E-03	2E-06
Cumulative Outdoor Risks	2E-03	2E-06
Resident Indoor Air Risks for each property		
9 Tufts Street - Left Unit ^{2,3}	2E-02	8E-06
9 Tufts Street - Right Unit ^{2,3}	2E-02	2E-05
11-13 Tufts Street ^{2,3}	2E-02	7E-06
17 Tufts Street ^{2,3}	3E-02	2E-05
19 Tufts Street ^{2,3}	3E-02	2E-05
23 Tufts Street ^{2,3}	2E-02	4E-06
25 Tufts Street ^{2,3}	2E-02	1E-05
27 Tufts Street ^{2,3}	2E-02	5E-06
Homebound Resident Indoor Air Risks for each property		
9 Tufts Street - Left Unit ^{2,3}	3E-02	9E-06
9 Tufts Street - Right Unit ^{2,3}	3E-02	2E-05
11-13 Tufts Street ^{2,3}	3E-02	7E-06
17 Tufts Street ^{2,3}	3E-02	2E-05
19 Tufts Street ^{2,3}	3E-02	2E-05
23 Tufts Street ^{2,3}	3E-02	5E-06
25 Tufts Street ^{2,3}	3E-02	1E-05
27 Tufts Street ^{2,3}	3E-02	5E-06
Resident Cumulative Indoor and Outdoor Pathways		
9 Tufts Street - Left Unit	3E-02	9E-06
9 Tufts Street - Right Unit	3E-02	2E-05
11-13 Tufts Street	3E-02	8E-06
17 Tufts Street	3E-02	2E-05
19 Tufts Street	3E-02	2E-05
23 Tufts Street	3E-02	6E-06
25 Tufts Street	3E-02	1E-05
27 Tufts Street	3E-02	7E-06

Notes:

Bolded values exceed MassDEP acceptable risk limits

Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor

Homebound Resident assumes exposure only to indoor pathways

¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.

²Temporal average concentrations were used to calculate indoor air risks.

³Assumes 30 year exposure.

Table RC-26
Risk Summary
Future Exposures: Commercial in Tufts Street Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	3E-05	1E-08
Soil particulate	1E-07	3E-11
Ambient Air (average of outdoor air)	1E-03	8E-07
Cumulative Outdoor Risk	1E-03	8E-07

Table RC-27
 Risk Summary
 Future Exposures: Construction Worker in Tufts Street Area
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	5E-05	1E-09
Soil particulate	8E-07	1E-11
Excavation Air (average of soil, groundwater and soil vapor)	3E-03	1E-06
Cumulative Outdoor Risk	3E-03	1E-06

Table RC-28
Risk Summary
Indoor Air Risks
Current Exposures: Resident in Other Streets Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	2E-03	1E-07
Soil particulate	6E-07	2E-10
Ambient Air (outdoor air)	2E-03	5E-07
Cumulative outdoor risks	4E-03	6E-07
Resident Indoor Air Risks for each property		
49 Tufts Street ^{1,3}	2E-02	5E-06
162-164 Glen Street ^{1,4}	2E-02	7E-06
4 Morton Street ^{1,3}	2E-02	8E-06
6-8 Morton Street ^{2,3}	2E-02	7E-06
10 Morton Street ^{2,3}	3E-02	5E-06
12 Morton Street ^{2,3}	2E-02	4E-06
18 Morton Street ^{2,3}	2E-02	6E-06
19-19A Morton Street ^{2,3}	3E-02	9E-06
12-14 Knowlton Street ^{2,3}	2E-02	5E-06
17 Knowlton Street ^{1,3}	2E-02	5E-06
23 Knowlton Street ^{2,3}	2E-02	6E-06
95 Franklin Street ^{1,4}	3E-02	1E-05
97 Franklin Street ^{1,3}	2E-02	5E-06
99 Franklin Street ^{1,3}	2E-02	7E-06
105-107 Washington Street ^{1,3}	2E-02	1E-05
111 Washington Street ^{2,3}	2E-02	5E-06
Homebound Resident Indoor Air Risks for each property		
49 Tufts Street ^{2,3}	3E-02	6E-06
162-164 Glen Street ^{2,3}	3E-02	8E-06
4 Morton Street ^{2,3}	3E-02	9E-06
6-8 Morton Street ^{2,3}	3E-02	8E-06
10 Morton Street ^{2,3}	3E-02	5E-06
12 Morton Street ^{2,3}	3E-02	5E-06
18 Morton Street ^{2,3}	3E-02	7E-06
19-19A Morton Street ^{2,3}	3E-02	1E-05
12-14 Knowlton Street ^{2,3}	3E-02	6E-06
17 Knowlton Street ^{2,3}	3E-02	5E-06
23 Knowlton Street ^{2,3}	3E-02	7E-06
95 Franklin Street ^{1,4}	3E-02	1E-05
97 Franklin Street ^{2,3}	3E-02	5E-06
99 Franklin Street ^{2,3}	3E-02	8E-06
105-107 Washington Street ^{2,3}	3E-02	1E-05
111 Washington Street ^{2,3}	3E-02	6E-06
Resident Cumulative Indoor and Outdoor Pathways		
49 Tufts Street ^{2,3}	3E-02	6E-06
162-164 Glen Street ^{2,3}	3E-02	8E-06
4 Morton Street ^{2,3}	3E-02	9E-06
6-8 Morton Street ^{2,3}	3E-02	8E-06
10 Morton Street ^{2,3}	3E-02	5E-06
12 Morton Street ^{2,3}	3E-02	5E-06
18 Morton Street ^{2,3}	3E-02	7E-06
19-19A Morton Street ^{2,3}	3E-02	9E-06
12-14 Knowlton Street ^{2,3}	3E-02	6E-06
17 Knowlton Street ^{2,3}	3E-02	6E-06
23 Knowlton Street ^{2,3}	3E-02	7E-06
95 Franklin Street ^{1,4}	3E-02	1E-05
97 Franklin Street ^{2,3}	3E-02	5E-06
99 Franklin Street ^{2,3}	3E-02	8E-06
105-107 Washington Street ^{2,3}	3E-02	1E-05
111 Washington Street ^{2,3}	3E-02	6E-06

Notes:
Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures
Homebound Resident assumes exposure only to indoor pathways
¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.
²Temporal average concentrations were used to calculate indoor air risks.
³Assumes 30 year exposure.
⁴Assumes EPEM will be installed within 5 years, therefore assumes 5 year exposure to indoor air.

Table RC-29
Risk Summary
Indoor Air Risks
Current Exposures: Commercial Worker in Other Streets Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Outdoor Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	1E-04	2E-08
Soil particulate	5E-07	7E-11
Ambient Air (average of outdoor air)	2E-03	3E-07
Cumulative Outdoor Risks	2E-03	3E-07
Indoor Air Risks for each Commercial Property		
163 Glen Street ²	4E-03	1E-06
85 Washington Street ²	4E-03	9E-07
91-95 Washington Street ²	4E-03	1E-06
97 Washington Street ²	5E-03	3E-06
121 Washington Street ²	4E-03	1E-06
Cumulative Indoor and Outdoor Pathways		
163 Glen Street ²	6E-03	2E-06
85 Washington Street ²	6E-03	1E-06
91-95 Washington Street ²	6E-03	1E-06
97 Washington Street ²	6E-03	3E-06
121 Washington Street ²	6E-03	1E-06

Notes:

Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures

¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.

²Temporal average concentrations were used to calculate indoor air risks.

Table RC-30
Risk Summary
Current Exposures: Capuano School
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	2E-03	3E-08
Soil particulate	2E-06	2E-11
Ambient Air (outdoor air)	6E-03	6E-08
Cumulative outdoor risks	8E-03	1E-07

Table RC-31
Risk Summary
Indoor Air Risks
Future Exposures: Resident in Other Streets Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Resident Outdoor Pathways		
Soil ingestion and dermal	4E-02	2E-06
Soil particulate	2E-05	5E-09
Ambient Air (outdoor air)	2E-03	5E-07
Cumulative outdoor risks	4E-02	3E-06
Resident Indoor Air Risks for each property		
163 Glen Street ^{2,3}	2E-02	8E-06
85 Washington Street ^{2,3}	2E-02	5E-06
91-95 Washington Street ^{2,3}	2E-02	2E-05
97 Washington Street ^{2,3}	2E-02	7E-06
105-107 Washington Street ^{2,3}	2E-02	1E-05
111 Washington Street ^{2,3}	2E-02	5E-06
121 Washington Street ^{2,3}	2E-02	6E-06
49 Tufts Street ^{2,3}	2E-02	5E-06
162-164 Glen Street ^{2,3}	2E-02	7E-06
4 Morton Street ^{2,3}	2E-02	8E-06
6-8 Morton Street ^{2,3}	2E-02	7E-06
10 Morton Street ^{2,3}	3E-02	5E-06
12 Morton Street ^{2,3}	2E-02	4E-06
18 Morton Street ^{2,3}	2E-02	6E-06
19-19A Morton Street ^{2,3}	3E-02	9E-06
12-14 Knowlton Street ^{2,3}	2E-02	5E-06
17 Knowlton Street ^{2,3}	2E-02	5E-06
23 Knowlton Street ^{2,3}	2E-02	6E-06
95 Franklin Street ^{1,4}	3E-02	1E-05
97 Franklin Street ^{2,3}	2E-02	5E-06
99 Franklin Street ^{2,3}	2E-02	7E-06
Homebound Resident Indoor Air Risks for each property		
163 Glen Street ^{2,3}	3E-02	9E-06
85 Washington Street ^{2,3}	3E-02	6E-06
91-95 Washington Street ^{2,3}	3E-02	2E-05
97 Washington Street ^{2,3}	3E-02	7E-06
105-107 Washington Street ^{2,3}	3E-02	1E-05
111 Washington Street ^{2,3}	3E-02	6E-06
121 Washington Street ^{2,3}	3E-02	7E-06
49 Tufts Street ^{2,3}	3E-02	6E-06
162-164 Glen Street ^{2,3}	3E-02	8E-06
4 Morton Street ^{2,3}	3E-02	9E-06
6-8 Morton Street ^{2,3}	3E-02	8E-06
10 Morton Street ^{2,3}	3E-02	5E-06
12 Morton Street ^{2,3}	3E-02	5E-06
18 Morton Street ^{2,3}	3E-02	7E-06
19-19A Morton Street ^{2,3}	3E-02	1E-05
12-14 Knowlton Street ^{2,3}	3E-02	6E-06
17 Knowlton Street ^{2,3}	3E-02	5E-06
23 Knowlton Street ^{2,3}	3E-02	7E-06
95 Franklin Street ^{1,4}	3E-02	1E-05
97 Franklin Street ^{2,3}	3E-02	5E-06
99 Franklin Street ^{2,3}	3E-02	8E-06
Resident Cumulative Indoor and Outdoor Pathways		
163 Glen Street ^{2,3}	7E-02	1E-05
85 Washington Street ^{2,3}	7E-02	8E-06
91-95 Washington Street ^{2,3}	7E-02	2E-05
97 Washington Street ^{2,3}	7E-02	9E-06
105-107 Washington Street ^{2,3}	7E-02	2E-05
111 Washington Street ^{2,3}	7E-02	8E-06
121 Washington Street ^{2,3}	7E-02	9E-06
49 Tufts Street ^{2,3}	7E-02	8E-06
162-164 Glen Street ^{2,3}	7E-02	1E-05
4 Morton Street ^{2,3}	7E-02	1E-05
6-8 Morton Street ^{2,3}	7E-02	1E-05
10 Morton Street ^{2,3}	7E-02	8E-06
12 Morton Street ^{2,3}	7E-02	7E-06
18 Morton Street ^{2,3}	7E-02	9E-06
19-19A Morton Street ^{2,3}	7E-02	1E-05
12-14 Knowlton Street ^{2,3}	7E-02	8E-06
17 Knowlton Street ^{2,3}	7E-02	8E-06
23 Knowlton Street ^{2,3}	7E-02	9E-06
95 Franklin Street ^{1,4}	7E-02	1E-05
97 Franklin Street ^{2,3}	7E-02	5E-06
99 Franklin Street ^{2,3}	7E-02	8E-06

Notes:
Values presented for "Cumulative Indoor and Outdoor Pathways" consider indoor/outdoor exposures
Homebound Resident assumes exposure only to indoor pathways
¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.
²Temporal average concentrations were used to calculate indoor air risks.
³Assumes 30 year exposure.
⁴Assumes EPEM will be installed/modified within 5 years, therefore assumes 5 year exposure to indoor air.

Table RC-32
 Risk Summary
 Indoor Air Risks
 Future Exposures: Commercial Worker in Other Streets Area
 50 Tufts Street, Somerville, MA
 UniFirst Corporation

Outdoor Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	3E-03	4E-07
Soil particulate	1E-05	2E-09
Ambient Air (average of outdoor air)	2E-03	3E-07
Cumulative Outdoor Risks	5E-03	6E-07
Indoor Air Risks for each Commercial Property		
163 Glen Street ²	4E-03	1E-06
85 Washington Street ²	4E-03	9E-07
91-95 Washington Street ¹	4E-03	1E-06
97 Washington Street ²	5E-03	3E-06
121 Washington Street ²	4E-03	1E-06
Cumulative Indoor and Outdoor Pathways		
Cumulative Indoor and Outdoor Risks at 165 Glen	9E-03	2E-06
Cumulative Indoor and Outdoor Risks at 85 Washington	9E-03	2E-06
Cumulative Indoor and Outdoor Risks at 91-95 Washington	9E-03	2E-06
Cumulative Indoor and Outdoor Risks at 97 Washington	9E-03	2E-06
Cumulative Indoor and Outdoor Risks at 121 Washington	9E-03	2E-06

Notes:
¹Not enough data to calculate a temporal average, therefore maximum concentrations were used to calculate indoor air risks.
²Temporal average concentrations were used to calculate indoor air risks.

Table RC-33
Risk Summary
Future Exposures: Capuano School Student
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	6E-02	6E-07
Soil particulate	5E-05	6E-10
Ambient Air (outdoor air)	6E-03	6E-08
Cumulative Outdoor Risk	7E-02	7E-07

Table RC-34
Risk Summary
Future Exposures: Construction Worker in Other Streets Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	2E-03	6E-08
Soil particulate	3E-05	9E-10
Excavation Air (average of soil, groundwater and soil vapor)	9E-03	1E-06
Cumulative Risk	1E-02	1E-06

Table RC-35
Risk Summary
Future Exposures: Worst-case Utility Worker in Neighborhood Streets Area
50 Tufts Street, Somerville, MA
UniFirst Corporation

Exposure Pathways	Non-Carcinogenic Risk	Carcinogenic Risk
Outdoor Pathways		
Soil ingestion and dermal	4E-07	8E-11
Soil particulate	6E-09	1E-12
Groundwater ingestion and dermal	4E-04	1E-07
Trench Air (average of ambient air values predicted from soil, groundwater and soil vapor data)	1E-04	2E-07
Cumulative Risk	5E-04	3E-07

Table RC-36
Risk Summary
50 Tufts Street, Somerville, MA
UnlFirst Cooperation

Exposure Area	Receptor	Time	Non-Carcinogenic Risk	Carcinogenic Risk	Exposure Pathways
The Property	Resident	Future	7E-03	3E-06	a, b, c
	Commercial Worker	Current	2E-03	1E-06	a, b, c
			6E-03	7E-06	a, b, c, d1
		Future	6E-03	7E-06	a, b, c, d2
			2E-03	1E-06	a, b, c
	Full-time Indoor Commercial Worker	Current and Future	6E-03	7E-06	d1
	Full-time Indoor Commercial Worker	Current and Future	6E-03	5E-06	d2
	Construction Worker	Future	6E-01	1E-05	a, b, e
	Utility Worker	Future	2E-02	2E-06	a, b, e, g
	Landscaper	Current	6E-04	7E-07	a, b, c
60 Tufts Street Area	Resident	Current and Future	2E-03	8E-07	a, b, c
	Commercial Worker	Future	1E-03	4E-07	a, b, c
	Construction Worker	Future	4E-04	1E-08	a, b, e
60 Tufts Street Area (Current Residence: 60 Tufts Street Unit 4)	Resident*	Current	3E-02	9E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	9E-06	a, b, c, d3
		Current and Future	3E-02	9E-06	d3
Alston Street Area	Resident	Current	2E-03	5E-07	a, b, c
	Commercial Worker	Future	2E-03	5E-07	a, b, c
		Future	1E-03	2E-07	a, b, c
		Future	3E-04	5E-09	a, b, e
Along Tufts Street Area	Resident	Current	3E-03	2E-06	a, b, c
	Commercial Worker	Future	2E-03	2E-06	a, b, c
		Future	1E-03	8E-07	a, b, c
		Future	3E-03	1E-06	a, b, e
Along Tufts Street Area (Current Residence: 9 Tufts Street - Left Unit)	Resident*	Current	3E-02	1E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	9E-06	a, b, c, d3
		Current and Future	3E-02	9E-06	d3
Along Tufts Street Area (Current Residence: 9 Tufts Street - Right Unit)	Resident*	Current	3E-02	2E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	2E-05	a, b, c, d3
		Current and Future	3E-02	2E-05	d3
Along Tufts Street Area (Current Residence: 11-13 Tufts Street)	Resident*	Current	3E-02	8E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	8E-06	a, b, c, d3
		Current and Future	3E-02	7E-06	d3
Along Tufts Street Area (Current Residence: 17 Tufts Street)	Resident*	Current	3E-02	2E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	2E-05	a, b, c, d3
		Current and Future	3E-02	2E-05	d3
Along Tufts Street Area (Current Residence: 19 Tufts Street)	Resident*	Current	3E-02	2E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	2E-05	a, b, c, d3
		Current and Future	3E-02	2E-05	d3
Along Tufts Street Area (Current Residence: 23 Tufts Street)	Resident*	Current	3E-02	6E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	6E-06	a, b, c, d3
		Current and Future	3E-02	5E-06	d3
Along Tufts Street Area (Current Residence: 25 Tufts Street)	Resident*	Current	3E-02	1E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	1E-05	a, b, c, d3
		Current and Future	3E-02	1E-05	d3
Along Tufts Street Area (Current Residence: 27 Tufts Street)	Resident*	Current	3E-02	7E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	7E-06	a, b, c, d3
		Current and Future	3E-02	5E-06	d3
Other Streets Area	Resident	Current	4E-03	6E-07	a, b, c
	Commercial Worker	Future	4E-02	3E-06	a, b, c
		Current	2E-03	3E-07	a, b, c
	Construction Worker	Future	5E-03	6E-07	a, b, c
		Future	1E-02	1E-06	a, b, e
	Capuano School Student	Current	8E-03	1E-07	a, b, c
Other Streets Area (Commercial Property: 163 Glen Street)	Resident*	Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	9E-06	d3
	Commercial Worker	Current	6E-03	2E-06	a, b, c, d3
	Commercial Worker	Future	9E-03	2E-06	a, b, c, d3
Other Streets Area (Commercial Property: 85 Washington Street)	Resident*	Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	6E-06	d3
	Commercial Worker	Current	6E-03	1E-06	a, b, c, d3
	Commercial Worker	Future	9E-03	2E-06	a, b, c, d3
Other Streets Area (Commercial Property: 91-95 Washington Street)	Resident*	Future	7E-02	2E-05	a, b, c, d3
	Homebound Resident*	Future	3E-02	2E-05	d3
	Commercial Worker	Current	6E-03	1E-06	a, b, c, d3
	Commercial Worker	Future	9E-03	2E-06	a, b, c, d3
Other Streets Area (Commercial Property: 97 Washington Street)	Resident*	Future	7E-02	9E-06	a, b, c, d3
	Homebound Resident*	Future	3E-02	7E-06	d3
	Commercial Worker	Current	6E-03	3E-06	a, b, c, d3
	Commercial Worker	Future	9E-03	2E-06	a, b, c, d3
Other Streets Area (Residential Property: 105-107 Washington)	Resident*	Current	3E-02	1E-05	a, b, c, d3
	Homebound Resident*	Future	7E-02	2E-05	a, b, c, d3
		Current and Future	3E-02	1E-05	d3
Other Streets Area (Residential Property: 111 Washington)	Resident*	Current	3E-02	8E-06	a, b, c, d3
	Homebound Resident*	Future	7E-02	1E-05	a, b, c, d3
		Current and Future	3E-02	6E-06	d3
Other Streets Area (Residential Property: 121 Washington)	Resident*	Current	3E-02	1E-06	a, b, c, d3
	Homebound Resident*	Future	7E-02	9E-06	a, b, c, d3
		Current and Future	3E-02	7E-06	d3
Other Streets Area (Residential Property: 49 Tufts Street)	Resident*	Current	3E-02	6E-06	a, b, c, d3
	Homebound Resident*	Future	7E-02	8E-06	a, b, c, d3
		Current and Future	3E-02	6E-06	d3
Other Streets Area (Residential Property: 162-164 Glen Street)	Resident*	Current	3E-02	8E-06	a, b, c, d3
	Homebound Resident*	Future	7E-02	1E-05	a, b, c, d3
		Current and Future	3E-02	8E-06	d3

Table RC-36
Risk Summary
50 Tufts Street, Somerville, MA
UniFirst Cooperation

Exposure Area	Receptor	Time	Non-Carcinogenic Risk	Carcinogenic Risk	Exposure Pathways
Other Streets Area (Residential Property: 4 Morton Street)	Resident*	Current	3E-02	9E-06	a, b, c, d3
		Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	9E-06	d3
Other Streets Area (Residential Property: 6-8 Morton Street)	Resident*	Current	3E-02	8E-06	a, b, c, d3
		Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	8E-06	d3
Other Streets Area (Residential Property: 10 Morton Street)	Resident*	Current	3E-02	5E-06	a, b, c, d3
		Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	5E-06	d3
Other Streets Area (Residential Property: 12 Morton Street)	Resident*	Current	3E-02	5E-06	a, b, c, d3
		Future	7E-02	7E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	5E-06	d3
Other Streets Area (Residential Property: 18 Morton Street)	Resident*	Current	3E-02	7E-06	a, b, c, d3
		Future	7E-02	9E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	7E-06	d3
Other Streets Area (Residential Property: 19-19A Morton Street)	Resident*	Current	3E-02	9E-06	a, b, c, d3
		Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	1E-05	d3
Other Streets Area (Residential Property: 12-14 Knowlton Street)	Resident*	Current	3E-02	6E-06	a, b, c, d3
		Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	6E-06	d3
Other Streets Area (Residential Property: 17 Knowlton Street)	Resident*	Current	3E-02	6E-06	a, b, c, d3
		Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	5E-06	d3
Other Streets Area (Residential Property: 23 Knowlton Street)	Resident*	Current	3E-02	7E-06	a, b, c, d3
		Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	7E-06	d3
Other Streets Area (Residential Property: 95 Franklin Street**)	Resident*	Current	3E-02	1E-05	a, b, c, d3
		Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	1E-05	d3
Other Streets Area (Residential Property: 97 Franklin Street**)	Resident*	Current	3E-02	5E-06	a, b, c, d3
		Future	7E-02	8E-06	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	5E-06	d3
Other Streets Area (Residential Property: 99 Franklin Street**)	Resident*	Current	3E-02	8E-06	a, b, c, d3
		Future	7E-02	1E-05	a, b, c, d3
	Homebound Resident*	Current and Future	3E-02	8E-06	d3
Within Neighborhood Streets Area	Utility Worker	Future	5E-04	3E-07	a, b, f, g

Notes:

- (a) Soil, ingestion and dermal contact
- (b) Soil, inhalation and ingestion of particulates
- (c) Air, ambient
- (d) Air, indoor
- (e) Air, excavation
- (f) Air, trench
- (g) Groundwater, ingestion and dermal contact
- (1) office indoor air
- (2) warehouse and garage indoor air
- (3) property indoor air (temporal average of indoor air data)

*Assumes 30 Year Indoor Air Exposure

*Assumes 5 Year Indoor Air Exposure

Commercial Worker results incorporate indoor and outdoor exposures unless otherwise noted.

Table RC-37
Comparison of Soil and Groundwater EPCs to UCLs
50 Tufts Street
Somerville, MA

	Massachusetts DEP Upper Concentration Limits		EPCs: Commercial Worker, Potential Future Resident, Construction Worker, Utility Worker, and Landscaper at the Property			EPCs: Residential Properties, Commercial Properties, and Construction workers on Alston Street Worst case			EPCs: Residents and Commercial Properties, and Construction Workers on Tufts Street Worst case		
	Soil	Groundwater	Soil	Soil	Groundwater	Soil	Soil	Groundwater	Soil	Soil	Groundwater
					Maximum of temporal averages			Maximum of temporal averages			Maximum of temporal averages
Compound	mg/kg	mg/L	Average 0-3'	Average 0-15'	mg/L	Maximum 0-3'	Maximum 0-15'	mg/L	Maximum 0-3'	Maximum 0-15'	mg/L
Carbon tetrachloride	4.0E+03	5.0E+01	4.7E-02	4.8E-02	1.4E-01	5.5E-02	4.5E-02	5.0E-04	8.0E-02	2.8E-02	5.0E-04
Chloroethane	NS	NS	1.2E-01	1.2E-01	2.5E-01	1.4E-01	1.1E-01	1.0E-03	2.0E-01	5.6E-02	1.0E-03
Chloroform	8.0E+03	1.0E+02	NA	NA	1.3E-01	5.5E-02	4.5E-02	5.0E-04	NA	2.8E-02	5.0E-04
Dichloroethane, 1,1-	1.0E+04	1.0E+02	NA	NA	1.5E-01	5.5E-02	4.5E-02	5.0E-04	8.5E-02	2.8E-02	1.3E-02
Dichloroethene, cis-1,2-	5.0E+03	1.0E+02	NA	NA	2.2E-01	5.5E-02	4.5E-02	5.0E-04	8.5E-02	2.8E-02	1.3E-02
Dichloroethene, 1,1-	1.0E+04	1.0E+02	NA	NA	3.1E+00	5.5E-02	4.5E-02	5.0E-04	8.5E-02	2.8E-02	1.3E-02
Tetrachloroethene	1.0E+04	1.0E+02	3.1E+00	1.1E+01	6.2E+01	5.5E-02	4.5E-02	5.3E-04	9.9E-02	3.2E-01	1.2E+01
Trans-1,2-Dichloroethene	1.0E+04	1.0E+02	4.7E-02	4.8E-02	1.3E-01	5.5E-02	4.5E-02	5.0E-04	8.0E-02	2.8E-02	5.0E-04
Trichloroethane, 1,1,1-	1.0E+04	1.0E+02	NA	NA	1.4E+02	5.5E-02	4.5E-02	5.0E-04	8.5E-02	8.0E-02	9.2E-02
Trichloroethene	1.0E+04	5.0E+01	6.7E-02	6.4E-02	1.1E+02	5.5E-02	4.5E-02	2.0E-03	8.0E-02	2.8E-02	1.0E-01
Vinyl chloride	3.0E+02	1.0E+02	4.7E-02	4.8E-02	1.3E-01	5.5E-02	4.5E-02	5.0E-04	8.0E-02	2.8E-02	5.0E-04

Table RC-37
Comparison of Soil and Groundwater EPCs to UCLs
50 Tufts Street
Somerville, MA

	Massachusetts DEP Upper Concentration Limits		EPCs: Residential Properties, Commercial Properties, and Construction on Other Streets* Worst case			EPCs: Residential Properties, Commercial Properties, and Construction workers on 60 Tufts Street Worst case		EPCs: Utility Worker within Neighborhood Streets Worst case		
	Soil	Groundwater	Soil	Soil	Groundwater	Soil	Groundwater	Soil	Groundwater	
				Maximum of temporal averages			Maximum of temporal averages		Maximum of temporal averages	
Compound	mg/kg	mg/L	Maximum 0-3'	Maximum 0-15'	mg/L	Maximum 0-15'	mg/L	Maximum 0-6'	mg/L	
Carbon tetrachloride	4.0E+03	5.0E+01	4.9E-02	3.7E-02	5.0E-04	4.8E-02	5.0E-04	2.8E-02	5.0E-04	
Chloroethane	NS	NS	1.2E-01	9.5E-02	1.5E-02	1.2E-01	1.0E-03	5.6E-02	1.0E-03	
Chloroform	8.0E+03	1.0E+02	4.9E-02	3.7E-02	8.9E-03	NA	5.0E-04	2.8E-02	1.3E-02	
Dichloroethane, 1,1-	1.0E+04	1.0E+02	1.3E-01	4.3E-01	7.7E-02	4.8E-02	4.9E-04	1.3E-01	4.9E-02	
Dichloroethene, cis-1,2-	5.0E+03	1.0E+02	4.9E-02	7.7E-01	2.0E-01	4.8E-02	5.0E-04	2.8E-02	6.6E-02	
Dichloroethene, 1,1-	1.0E+04	1.0E+02	4.9E-02	4.9E-01	4.3E-02	4.8E-02	4.2E-03	2.8E-02	2.9E-02	
Tetrachloroethene	1.0E+04	1.0E+02	9.9E-01	5.9E+01	6.7E+00	1.8E-01	2.9E-02	9.9E-01	1.2E+01	
Trans-1,2-Dichloroethene	1.0E+04	1.0E+02	4.9E-02	3.7E-02	7.6E-03	4.8E-02	5.0E-04	2.8E-02	1.3E-02	
Trichloroethane, 1,1,1-	1.0E+04	1.0E+02	7.7E-02	7.7E-02	9.1E-02	4.8E-02	1.8E-02	7.7E-02	9.2E-02	
Trichloroethene	1.0E+04	5.0E+01	3.6E-01	6.2E+00	1.5E-01	3.4E-02	6.0E-03	3.6E-01	1.4E-01	
Vinyl chloride	3.0E+02	1.0E+02	4.9E-02	3.7E-02	5.8E-02	4.8E-02	5.0E-04	2.8E-02	1.3E-02	

NA = no data were available for this compound in this medium
NS = No UCL value is available from MassDEP

ATTACHMENT A
RISK CALCULATIONS

Tables of Exposure and Risk Estimates												
Exposure Point	Medium	Exposure Pathway	Current Commercial Worker	Current Homebound Resident	Current Resident	Current Maintenance Worker / Landscaper	Current Student at Capuano Center	Current/Future Utility Worker	Future Construction Worker	Future Commercial Worker	Future Homebound Resident	Future Student at School
Property	Soil	Ingestion/Dermal	A1			A6		A26	A18	A12		A9
	Soil Particulates	Inhalation	A2			A7		A27	A19	A13		A10
	Groundwater	Ingestion/Dermal						A28				
	Ambient Air	Inhalation	A3			A8		A29-A34	A20-A25	A14		A11
	Indoor Air	Inhalation	A4-A5									A17
60 Tufts	Soil	Ingestion/Dermal			A35				A41	A38		A35
	Soil Particulates	Inhalation			A36				A42	A39		A36
	Groundwater	Ingestion/Dermal										
	Ambient Air	Inhalation			A37				A43-A48	A40		A37
	Indoor Air	Inhalation		A128	A128 ^a						A128	A128 ^a
Tufts Street Area	Soil	Ingestion/Dermal			A66				A75	A72		A69
	Soil Particulates	Inhalation			A67				A76	A73		A70
	Groundwater	Ingestion/Dermal										
	Ambient Air	Inhalation			A68				A77-A82	A74		A71
	Indoor Air	Inhalation		A129							A129	
	Indoor Air	Inhalation		A130							A130	
	Indoor Air	Inhalation		A131							A131	
	Indoor Air	Inhalation		A132							A132	
	Indoor Air	Inhalation		A133							A133	
	Indoor Air	Inhalation		A134							A134	
	Indoor Air	Inhalation		A135							A135	
	Indoor Air	Inhalation		A136							A136	
	Soil	Ingestion/Dermal			A49				A58	A55		A52
	Soil Particulates	Inhalation			A50				A59	A56		A53
	Groundwater	Ingestion/Dermal										
	Ambient Air	Inhalation			A51				A60-A65	A57		A54
Other Streets Area	Soil	Ingestion/Dermal	A86		A83		A94		A111	A105		A97
	Soil Particulates	Inhalation	A87		A84		A95		A112	A106		A98
	Groundwater	Ingestion/Dermal										
	Ambient Air	Inhalation	A88		A85		A96		A113-A118	A107		A99
	Indoor Air	Inhalation	A89							A89 ^b	A100	A100 ^a
	Indoor Air	Inhalation	A90							A90 ^b	A101	A101 ^a
	Indoor Air	Inhalation	A91							A91 ^b	A102	A102 ^a
	Indoor Air	Inhalation	A92							A92 ^b	A103	A103 ^a
	Indoor Air	Inhalation	A93							A93 ^b	A104	A104 ^a
	Indoor Air	Inhalation		A137	A137 ^a						A137	A137 ^a
	Indoor Air	Inhalation		A138	A138 ^a						A138	A138 ^a
	Indoor Air	Inhalation		A139	A139 ^a						A139	A139 ^a
	Indoor Air	Inhalation		A140	A140 ^a						A140	A140 ^a
	Indoor Air	Inhalation		A141	A141 ^a						A141	A141 ^a
	Indoor Air	Inhalation		A142	A142 ^a						A142	A142 ^a
	Indoor Air	Inhalation		A143	A143 ^a						A143	A143 ^a
	Indoor Air	Inhalation		A144	A144 ^a						A144	A144 ^a
	Indoor Air	Inhalation		A145	A145 ^a						A145	A145 ^a
	Indoor Air	Inhalation		A146	A146 ^a						A146	A146 ^a
	Indoor Air	Inhalation		A147	A147 ^a						A147	A147 ^a
	Indoor Air	Inhalation		A148	A148 ^a						A148	A148 ^a
	Indoor Air	Inhalation		A149	A149 ^a						A149	A149 ^a
	Indoor Air	Inhalation		A150	A150 ^a						A150	A150 ^a
	Indoor Air	Inhalation		A151	A151 ^a						A151	A151 ^a
	Indoor Air	Inhalation		A152	A152 ^a						A152	A152 ^a
	Soil	Ingestion/Dermal						A119				
	Soil Particulates	Inhalation						A120				
	Groundwater	Ingestion/Dermal						A121				
	Ambient Air	Inhalation						A122-A127				
	Indoor Air	Inhalation										

Notes:
a = Residential exposures to indoor air adjusted to represent fraction of time spent outdoors; see text.
b = Future commercial worker = current commercial worker.

Table A-1
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at 50 Tufts St.
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	50	
IR _{soil} TWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-c1	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFOsc	ADDing-c mg/kg-d	Risking	RAFOsnc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFDsc	ADDder-c mg/kg-d	Riskder	RAFDsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	4.7E-02	0.0007	0.13	1	5E-09	6E-10	1	1E-08	2E-05	0.1	1E-09	1E-10	0.1	3E-09	4E-06	8E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-08	8E-08	NC	NA	NA	0.1	7E-09	2E-08	NA	1E-07
Chloroform	NA	0.01	NA	NC	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.1	NA	NC	NA	NA	1.3	NA	NA	NC	NA	NA	0.13	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	0.01	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Tetrachloroethene	3.1E+00	0.01	0.051	1	3E-07	2E-08	1	8E-07	8E-05	0.1	7E-08	3E-09	0.1	2E-07	2E-05	2E-08	1E-04
Trans-1,2-Dichloroethene	4.7E-02	0.02	NA	NC	NA	NA	1	1E-08	6E-07	NC	NA	NA	0.1	3E-09	1E-07	NA	8E-07
Trichloroethane, 1,1,1-	NA	0.09	NA	NC	NA	NA	1	NA	9E-06	NC	NA	2E-11	0.1	4E-09	2E-06	NA	NA
Trichloroethene	6.7E-02	0.002	0.011	1	7E-09	8E-11	1	2E-08	4E-06	0.1	1E-09	2E-09	0.1	3E-09	9E-07	9E-11	1E-05
Vinyl chloride	4.7E-02	0.003	1.4	1.53	8E-09	1E-08	1	1E-08	4E-06	0.16	2E-09	2E-09	0.1	3E-09	1E-08	1E-08	5E-06
Total						3E-08			1E-04			6E-09			2E-05	3E-08	1E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-2
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Current Commercial Worker at 50 Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
fRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM^{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFinc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.7E-02	1.5E-09	0.43	0.000015	0.00007	0.13	1	2E-11	5E-11	8E-13	5E-11	6E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	7E-12	2E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	3E-10	3E-11	3E-10	7E-10	NA	8E-10
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	NA	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	NA	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1,1-	NA	NA	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	3.1E+00	9.8E-08	4.6	0.00001	0.02	0.051	1	1E-09	3E-09	3E-11	3E-09	2E-10	1	3E-09	9E-09	2E-09	8E-09	8E-07	2E-10	8E-07
Trans-1,2-Dichloroethene	4.7E-02	1.5E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	NA	8E-09
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	6.7E-02	2.1E-09	0.18	0.0000017	0.002	0.011	1	2E-11	7E-11	1E-13	6E-11	7E-13	1	6E-11	2E-10	1E-09	2E-10	8E-08	8E-13	8E-08
Vinyl chloride	4.7E-02	1.5E-09	0.1	0.0000088	0.003	1.4	1	2E-11	5E-11	5E-13	5E-11	6E-11	1	4E-11	1E-10	1E-09	1E-10	4E-08	6E-11	4E-08
Total										4E-11		2E-10				7E-09		1E-06	3E-10	1E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-3
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at 50 Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiC	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-05	9E-05	NA	9E-05
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-05	1E-03	NA	1E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-05	2E-04	NA	2E-04
Tetrachloroethene	5.5E-03	4.6	0.00001	1	2E-04	2E-06	1	6E-04	1E-04	2E-06	1E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-05	6E-04	NA	6E-04
Trichloroethane, 1,1,1-	8.8E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.9E-04	0.18	0.0000017	1	3E-05	5E-08	1	8E-05	4E-04	5E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	9E-08	1	3E-05	3E-04	9E-08	3E-04
Total						2E-06			3E-03	2E-06	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-4
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at 50 Tufts St.
Indoor Air
50 Tufts Office (NO & SO)

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	50 Tufts Office (NO & SO)
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HL_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC		RfC (mg/m3)	URF 1/(ug/m3)	Risk			HI (Indoor Air)
	Indoor Air (mg/m3)	ADE-c mg/m3	RAFc	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh
Carbon tetrachloride	NA	NA	1	NA	NA	1	NA	NA
Chloroethane	NA	NA	NC	NA	NA	1	NA	NA
Chloroform	NA	NA	1	0.000023	NA	1	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NC	NA	NA	1	9E-05	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NC	NA	NA	1	9E-05	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	1	NA	NA	1	9E-05	5E-04
Tetrachloroethene	8.2E-03	4.6	1	0.00001	7E-06	1	2E-03	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NC	NA	NA	1	9E-05	1E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NC	NA	NA	1	1E-04	2E-05
Trichloroethene	5.5E-04	0.18	1	0.000017	8E-08	1	1E-04	7E-04
Vinyl chloride	2.6E-04	0.1	1	0.0000088	2E-07	1	6E-05	6E-04
Total					8E-06			6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-5
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at 50 Tufts St.
Indoor Air
50 Tufts Warehouse and garage

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	50 Tufts Warehouse and garage
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Exposure Period - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	NC	NA	NA	1	9E-05	5E-04	NA	5E-04
Tetrachloroethene	8.3E-03	4.6	0.00001	1	7E-04	7E-06	1	2E-03	4E-04	7E-06	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	5.5E-04	0.18	0.0000017	1	5E-05	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	2E-05	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total						8E-06			6E-03	8E-06	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-6
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Current Landscaper at 50 Tufts St.
Soil

Receptor:	▼
Medium:	▼
Exposure Area:	▼
Depth:	▼
Duration:	▼

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.19	
EF	Soil Exposure Frequency	d/y	30	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	ADDder-nc mg/kg-d			
Carbon tetrachloride	4.7E-02	0.007	0.13	1	3E-09	3E-10	1	7E-09	4E-09	6E-07	6E-10	2E-06
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	2E-08	1E-08	3E-08	NA	7E-08
Chloroform	NA	0.01	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	1	NA	NC	NA	NA	1.3	NA	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	0.1	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Tetrachloroethene	3.1E+00	0.1	0.051	1	2E-07	9E-09	1	4E-07	3E-07	3E-06	1E-08	7E-06
Trans-1,2-Dichloroethene	4.7E-02	0.2	NA	NC	NA	NA	1	7E-09	4E-09	2E-08	NA	6E-08
Trichloroethane, 1,1,1-	NA	0.9	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Trichloroethene	6.7E-02	0.02	0.011	1	4E-09	4E-11	1	1E-08	6E-09	3E-07	7E-11	8E-07
Vinyl chloride	4.7E-02	0.003	1.4	1.53	4E-09	6E-09	1	7E-09	4E-09	1E-06	9E-09	4E-06
Total						1E-08				5E-06	2E-08	1E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-7
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
UnFirst
Current Landscaper at 50 Tufts St.
Ambient Air

Receptor:	Landscaper
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	30	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

	EPC	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFinc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Compound	Soil (mg/kg)	Fugitive Dust (mg/m3)																		
Carbon tetrachloride Chloroethane Chloroform Dichloroethane, 1,1- Dichloroethane, cis-1,2- Dichloroethane, 1,1- Tetrachloroethene Trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride Total	4.7E-02	2.8E-09	0.43	0.000015	0.007	0.13	1	2E-11	8E-11	1E-12	7E-11	9E-12	1	6E-11	2E-10	5E-10	2E-10	3E-08	1E-11	3E-08
	1.2E-01	7.1E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	5E-11	4E-10	1E-09	NA	1E-09
	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
	NA	NA	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
	NA	NA	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
	NA	NA	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
	3.1E+00	1.8E-07	4.6	0.00001	0.1	0.051	1	1E-09	5E-09	5E-11	4E-09	2E-10	1	4E-09	1E-08	3E-09	1E-08	1E-07	3E-10	1E-07
	4.7E-02	2.8E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	3E-10	2E-10	9E-10	NA	1E-09
	NA	NA	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
	6.7E-02	4.0E-09	0.18	0.0000017	0.02	0.011	1	3E-11	1E-10	2E-13	1E-10	1E-12	1	8E-11	3E-10	2E-09	2E-10	1E-08	1E-12	1E-08
	4.7E-02	2.8E-09	0.1	0.0000088	0.003	1.4	1	2E-11	8E-11	7E-13	7E-11	9E-11	1	6E-11	2E-10	2E-09	2E-10	6E-08	1E-10	6E-08
											5E-11		3E-10			7E-09		2E-07	4E-10	2E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-8
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Landscaper at 50 Tufts St.
Ambient Air

Receptor:	Landscaper
Medium of Origin:	Soil Gas
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	Shallow
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	5	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	1E-05	3E-04	NA	3E-04
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	1E-05	5E-05	NA	5E-05
Tetrachloroethene	5.5E-03	4.6	0.00001	1	6E-05	6E-07	1	2E-04	3E-05	6E-07	3E-05
Trans-1,2-Dichloroethene	4.0E-04	0.7	NA	NC	NA	NA	1	1E-05	2E-05	NA	2E-05
Trichloroethane, 1,1,1-	8.8E-04	5.2	NA	NC	NA	NA	1	2E-05	5E-06	NA	5E-06
Trichloroethene	6.9E-04	0.18	0.0000017	1	7E-06	1E-08	1	2E-05	1E-04	1E-08	1E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	3E-06	2E-08	1	7E-06	7E-05	2E-08	7E-05
Total						6E-07			6E-04	6E-07	6E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-9
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Future Resident at 50 Tufts St.
Soil

Receptor:	Resident
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-cf	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPc	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Exposure Period - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times TWA \times RAF_{os} \times EF}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{os} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CSF$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	4.8E-02	0.0007	0.13	1	2E-08	2E-09	1	1E-07	2E-04	0.1	2E-08	2E-09	0.1	1E-07	1E-04	5E-09	3E-04
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-07	7E-07	NA	NA	NA	0.1	2E-07	6E-07	NA	1E-06
Chloroform	NA	0.01	NA	NC	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.1	NA	NC	NA	NA	1.3	NA	NA	NC	NA	NA	0.13	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	0.01	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	0.01	0.051	1	4E-06	2E-07	1	3E-05	3E-03	0.1	4E-06	2E-07	0.1	2E-05	2E-03	4E-07	5E-03
Trans-1,2-Dichloroethene	4.8E-02	0.02	NA	NC	NA	NA	1	1E-07	6E-06	NC	NA	NA	0.1	1E-07	5E-06	NA	1E-05
Trichloroethane, 1,1,1-	NA	0.09	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Trichloroethene	6.4E-02	0.002	0.011	1	2E-08	3E-10	1	2E-07	8E-05	0.1	2E-08	3E-10	0.1	1E-07	7E-05	5E-10	1E-04
Vinyl chloride	4.8E-02	0.003	1.4	1.53	3E-08	4E-08	1	1E-07	4E-05	0.16	3E-08	4E-08	0.1	1E-07	3E-05	8E-08	7E-05
Total						3E-07			3E-03			3E-07			3E-03	5E-07	5E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-10
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Future Resident at 50 Tufts St.
Ambient Air

Receptor:	Resident
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.6	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$

$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

	EPC	EPC	RIC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFinc	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates In Air) YC-OC-A	HI (Particulates In Air) YC
Compound	Soil (mg/kg)	Fugitive Dust (mg/m3)																		
Carbon tetrachloride	4.8E-02	1.5E-09	0.43	0.000015	0.0007	0.13	1	2E-11	8E-11	1E-12	9E-11	1E-11	1	5E-11	2E-10	4E-10	2E-10	2E-07	2E-07	2E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	5E-11	4E-10	1E-09	1E-09	1E-09
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	NA	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	NA	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	NA	0.2	NA	0.05	NA	1	NA	NA	2E-10	2E-08	1E-09	1	1E-08	4E-08	9E-09	4E-08	4E-06	4E-06	4E-06
Tetrachloroethene	1.1E+01	3.6E-07	4.6	0.00001	0.01	0.051	1	5E-09	2E-08	NA	NA	NA	1	5E-11	2E-10	3E-09	2E-10	8E-09	1E-08	1E-08
Trans-1,2-Dichloroethene	4.8E-02	1.5E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.09	NA	NC	NA	NA	2E-13	1E-10	1E-12	1	7E-11	2E-10	1E-09	2E-10	1E-07	1E-07	1E-07
Trichloroethene	6.4E-02	2.0E-09	0.18	0.0000017	0.002	0.011	1	3E-11	1E-10	7E-13	9E-11	1E-10	1	5E-11	2E-10	2E-09	2E-10	5E-08	5E-08	5E-08
Vinyl chloride	4.8E-02	1.5E-09	0.1	0.0000088	0.003	1.4	1	2E-11	8E-11	2E-10		1E-09				2E-08		4E-06	4E-06	4E-06
Total										2E-10		1E-09								

NA - Not available
NC - Not calculated
ND - Not detected

Table A-11
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at 50 Tufts St.
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	5.5E-03	4.6	0.00001	1	3E-04	3E-06	1	8E-04	2E-04	3E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane, 1,1,1-	8.8E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.9E-04	0.18	0.000017	1	4E-05	7E-08	1	9E-05	5E-04	7E-08	5E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						3E-06			4E-03	3E-06	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-12
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Future Commercial Worker at 50 Tufts St.
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	50	
IR _{soil} TWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFDsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	4.8E-02	0.0007	0.13	1	5E-09	6E-10	1	1E-08	2E-05	0.1	1E-09	1E-10	0.1	3E-09	4E-06	8E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-08	8E-08	NC	NA	NA	0.1	7E-09	2E-08	NA	1E-07
Chloroform	NA	0.01	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.1	NA	NC	NA	NA	1.3	NA	NA	NC	NA	NA	0.13	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	0.01	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	0.01	0.051	1	1E-06	6E-08	1	3E-06	3E-04	0.1	2E-07	1E-08	0.1	6E-07	6E-05	7E-08	4E-04
Trans-1,2-Dichloroethene	4.8E-02	0.02	NA	NC	NA	NA	1	1E-08	6E-07	NC	NA	NA	0.1	3E-09	1E-07	NA	8E-07
Trichloroethane, 1,1,1-	NA	0.09	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Trichloroethene	6.4E-02	0.002	0.011	1	7E-09	7E-11	1	2E-08	9E-06	0.1	1E-09	2E-11	0.1	4E-09	2E-06	9E-11	1E-05
Vinyl chloride	4.8E-02	0.003	1.4	1.53	8E-09	1E-08	1	1E-08	4E-06	0.16	2E-09	2E-09	0.1	3E-09	9E-07	1E-08	5E-06
Total						7E-08			3E-04			1E-08			7E-05	8E-08	4E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-13
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Future Commercial Worker at 50 Tufts St
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gt} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gt}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gt} \times CSF) + (ADE_{inh} \times URF \times C)$$

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATN	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFin	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.8E-02	1.5E-09	0.43	0.000015	0.0007	0.13	1	2E-11	5E-11	8E-13	5E-11	6E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	2E-07	
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	3E-10	3E-11	3E-10	7E-10	8E-10	
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, 1,1-	NA	NA	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, cis-1,2-	NA	NA	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethene, 1,1-	NA	NA	0.2	NA	0.05	NA	1	4E-09	1E-08	1E-10	1E-08	5E-10	1	9E-09	3E-08	7E-09	3E-06	7E-10	3E-06	
Tetrachloroethene	1.1E+01	3.6E-07	4.6	0.00001	0.01	0.051	1	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	8E-09	
Trans-1,2-Dichloroethene	4.8E-02	1.5E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	7E-13	1	5E-11	2E-10	1E-09	2E-10	8E-08	8E-08	
Trichloroethene	6.4E-02	2.0E-09	0.18	0.0000017	0.002	0.011	1	2E-11	7E-11	1E-13	6E-11	7E-13	1	5E-11	1E-10	1E-09	1E-10	6E-11	4E-08	
Vinyl chloride	4.8E-02	1.5E-09	0.1	0.0000088	0.003	1.4	1	2E-11	5E-11	5E-13	5E-11	6E-11	1	4E-11	1E-10	1E-09	1E-10	4E-08	4E-08	
Total										1E-10		6E-10				1E-08		3E-06	3E-06	

NA - Not available
NC - Not calculated
ND - Not detected

Table A-14
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Commercial Worker at 50 Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-05	9E-05	NA	9E-05
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-05	1E-03	NA	1E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-05	2E-04	NA	2E-04
Tetrachloroethene	5.5E-03	4.6	0.00001	1	2E-04	2E-06	1	6E-04	1E-04	2E-06	1E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-05	6E-04	NA	6E-04
Trichloroethane, 1,1,1-	8.8E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.9E-04	0.18	0.0000017	1	3E-05	5E-08	1	8E-05	4E-04	5E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	9E-08	1	3E-05	3E-04	9E-08	3E-04
Total						2E-06			3E-03	2E-06	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-15
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Future Landscaper at 50 Tufts St.
Soil

Receptor:	▼
Medium:	▼
Exposure Area:	▼
Depth:	▼
Duration:	▼

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.19	
EF	Soil Exposure Frequency	d/y	30	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{soil} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Risking	RAFosnc	ADDing-nc mg/kg-d	Hiling	Dermal Contact			Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
				RAFosc	ADDing-c mg/kg-d						RAFds	ADDder-c mg/kg-d	Riskder	RAFDsnc mg/kg-d		
Carbon tetrachloride	4.8E-02	0.007	0.13	1	3E-09	3E-10	3E-10	1	7E-09	1E-06	0.1	2E-09	2E-10	0.1	6E-10	2E-06
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	NA	1	2E-08	4E-08	NC	NA	NA	0.1	NA	7E-08
Chloroform	NA	0.01	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA
Dichloroethane, 1,1-	NA	1	NA	NC	NA	NA	NA	1.3	NA	NA	NC	NA	NA	0.13	NA	NA
Dichloroethene, cis-1,2-	NA	0.1	NA	NC	NA	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA
Tetrachloroethene	1.1E+01	0.1	0.051	1	6E-07	3E-08	3E-08	1	2E-06	2E-05	0.1	4E-07	2E-08	0.1	5E-08	3E-05
Trans-1,2-Dichloroethene	4.8E-02	0.2	NA	NC	NA	NA	NA	1	7E-09	3E-08	NC	NA	NA	0.1	NA	6E-08
Trichloroethane, 1,1,1-	NA	0.9	NA	NC	NA	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA
Trichloroethene	6.4E-02	0.02	0.011	1	4E-09	4E-11	4E-11	1	9E-09	5E-07	0.1	2E-09	3E-11	0.1	6E-11	8E-07
Vinyl chloride	4.8E-02	0.003	1.4	1.53	4E-09	6E-09	6E-09	1	7E-09	2E-06	0.16	3E-09	4E-09	0.1	1E-08	4E-06
Total						4E-08	4E-08			2E-05			2E-08		6E-08	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-16
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Future Landscaper at 50 Tufts St.
Ambient Air

Receptor:	Landscaper
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m ³ /hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m ³ -y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m ³	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	dy	30	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

	EPC	EPC	RTC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hfling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Compound		Fugitive Dust (mg/m3)																		
Carbon tetrachloride	4.8E-02	2.9E-09	0.43	0.000015	0.007	0.13	1	2E-11	8E-11	1E-12	7E-11	9E-12	1	6E-11	2E-10	5E-10	2E-10	3E-08	3E-08	
Chloroethane	1.2E-01	7.2E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	5E-11	4E-10	1E-09	1E-09	
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, 1,1-	NA	NA	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, cis-1,2-	NA	NA	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethene, 1,1-	NA	NA	0.2	NA	0.05	0.051	1	5E-09	2E-08	2E-10	2E-08	8E-10	1	1E-08	5E-08	1E-08	4E-07	1E-09	4E-07	
Tetrachloroethene	1.1E+01	6.7E-07	4.6	0.00001	0.1	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	3E-10	2E-10	9E-10	1E-09	
Trans-1,2-Dichloroethene	4.8E-02	2.9E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.9	0.011	1	3E-11	1E-10	2E-13	9E-11	1E-12	1	8E-11	3E-10	2E-09	2E-10	1E-08	1E-08	
Trichloroethene	6.4E-02	3.8E-09	0.18	0.0000017	0.02	0.011	1	2E-11	8E-11	7E-13	7E-11	1E-10	1	6E-11	2E-10	2E-09	2E-10	6E-08	6E-08	
Vinyl chloride	4.8E-02	2.9E-09	0.1	0.0000088	0.003	1.4	1	2E-11	8E-11	2E-10	2E-10	9E-10	1	6E-11	2E-10	1E-08	5E-07	1E-09	5E-07	
Total																				

NA - Not available
NC - Not calculated
ND - Not detected

Table A-17
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Landscaper at 50 Tufts St.
Ambient Air

Receptor:	Landscaper	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time-- Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	5	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	1E-05	3E-04	NA	3E-04
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	1E-05	5E-05	NA	5E-05
Tetrachloroethene	5.5E-03	4.6	0.00001	1	6E-05	6E-07	1	2E-04	3E-05	6E-07	3E-05
Trans-1,2-Dichloroethene	4.0E-04	0.7	NA	NC	NA	NA	1	1E-05	2E-05	NA	2E-05
Trichloroethane, 1,1,1-	8.8E-04	5.2	NA	NC	NA	NA	1	2E-05	5E-06	NA	5E-06
Trichloroethene	6.9E-04	0.18	0.0000017	1	7E-06	1E-08	1	2E-05	1E-04	1E-08	1E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	3E-06	2E-08	1	7E-06	7E-05	2E-08	7E-05
Total						6E-07			6E-04	6E-07	6E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-18
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 50 Tufts St.
Soil - Dermal Contact & Incidental Ingestion
0-15 feet

Receptor:	Construction Worker
Medium:	Surface Soil
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.29	
EF	Soil Exposure Frequency	d/y	130	
EP	Soil Exposure Period - Cancer	y	1	
EP	Soil Exposure Period - Non-Cancer	y	1	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	182	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{as} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

	EPC Contact & Incidental Ingestion 0-15 (mg/kg)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion				Dermal Contact				Total					
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	HLing	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdscnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil)	HI (Soil)
Compound																	
Carbon tetrachloride	4.8E-02	0.007	0.13	1	4E-10	5E-11	1	6E-08	8E-06	0.1	4E-10	5E-11	0.1	6E-08	8E-06	1E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	1E-07	4E-07	NC	NA	NA	0.1	1E-07	4E-07	NA	7E-07
Chloroform	NA	0.01	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	1	NA	NC	NA	NA	1.3	NA	NA	NC	NA	NA	0.13	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	0.1	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	0.1	0.051	1	1E-07	5E-09	1	1E-05	1E-04	0.1	1E-07	5E-09	0.1	1E-05	1E-04	1E-08	3E-04
Trans-1,2-Dichloroethene	4.8E-02	0.2	NA	NC	NA	NA	1	6E-08	3E-07	NC	NA	NA	0.1	6E-08	3E-07	NA	6E-07
Trichloroethane, 1,1,1-	NA	0.9	NA	NC	NA	NA	1	NA	NA	NC	NA	NA	0.1	NA	NA	NA	NA
Trichloroethene	6.4E-02	0.02	0.011	1	6E-10	6E-12	1	8E-08	4E-06	0.1	6E-10	6E-12	0.1	8E-08	4E-06	1E-11	8E-06
Vinyl chloride	4.8E-02	0.003	1.4	1.53	6E-10	9E-10	1	6E-08	2E-05	0.16	7E-10	9E-10	0.1	6E-08	2E-05	2E-09	4E-05
Total						6E-09			2E-04			6E-09			2E-04	1E-08	3E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-19
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Construction Worker at 50 Tufts St.
Ambient Air
Excavation
0-15 feet

Receptor:	Construction Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	130	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	182	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM^{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil Excavation 0-15 feet (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFire	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.8E-02	2.9E-09	0.43	0.000015	0.007	0.13	1	4E-12	1E-11	2E-13	1E-11	1E-12	1	5E-10	2E-09	4E-09	2E-09	2E-07	2E-07	
Chloroethane	1.2E-01	7.2E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-09	4E-09	4E-10	4E-09	1E-08	1E-08	
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, 1,1-	NA	NA	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethene, cis-1,2-	NA	NA	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethene, 1,1-	NA	NA	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	1E-07	4E-07	9E-08	4E-07	4E-06	4E-06	
Tetrachloroethene	1.1E+01	6.7E-07	4.6	0.00001	0.1	0.051	1	8E-10	3E-09	3E-11	3E-09	1E-10	1	5E-10	2E-09	3E-09	2E-09	8E-09	1E-08	
Trans-1,2-Dichloroethene	4.8E-02	2.9E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	2E-13	1	7E-10	2E-09	1E-08	2E-09	1E-07	1E-07	
Trichloroethene	6.4E-02	3.8E-09	0.18	0.0000017	0.02	0.011	1	5E-12	2E-11	3E-14	1E-11	2E-11	1	5E-10	2E-09	2E-08	2E-09	5E-07	5E-07	
Vinyl chloride	4.8E-02	2.9E-09	0.1	0.0000088	0.003	1.4	1	4E-12	1E-11	1E-13	1E-11	2E-11	1	5E-10	2E-09	1E-07	2E-09	5E-07	5E-06	
Total										3E-11		1E-10				1E-07		4E-06	2E-10	

NA - Not available
NC - Not calculated
ND - Not detected

Table A-20
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 50 Tufts St.

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H_{TS}	Defl Vadose Zone (Layer A + Layer B)	Defl Total (Layer A + Layer B + Layer C)	Deflcrack (Layer A)	Exponent of Peclet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.5E+02	1.53E-03	6.95E-03	9.35E-05	6.13E-06	3.91E-02	2.56E-03
Chloroethane	4.77E-01	5.35E-02	3.80E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.64E-02	3.25E-04	2.13E-05	1.10E-01	7.21E-03
Chloroform	8.04E-02	2.05E-02	1.46E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	5.06E-03	1.25E-04	8.17E-06	7.13E-03	4.67E-04
Dichloroethane, 1,1-	1.24E-01	1.46E-02	1.04E-02	1.46E-02	2.74E+109	5.3E+01	1.15E-03	5.25E-03	8.89E-05	5.83E-06	7.86E-03	5.15E-04
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	1.03E-02	1.45E-02	2.13E+110	3.6E+01	1.17E-03	5.34E-03	8.82E-05	5.78E-06	5.52E-03	3.62E-04
Dichloroethene, 1,1-	6.34E-01	1.78E-02	1.26E-02	1.78E-02	1.68E+90	6.5E+01	2.51E-03	1.14E-02	1.08E-04	7.07E-06	4.86E-02	3.18E-03
Tetrachloroethene	3.24E-01	1.42E-02	1.01E-02	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.83E-03	8.63E-05	5.65E-06	1.99E-02	1.30E-03
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	9.91E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	7.75E-03	8.48E-05	5.55E-06	1.28E-02	8.42E-04
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.4E+02	1.29E-03	5.85E-03	9.35E-05	6.13E-06	2.43E-02	1.59E-03
Trichloroethene	1.97E-01	1.56E-02	1.11E-02	1.56E-02	6.13E+102	9.4E+01	1.14E-03	5.18E-03	9.47E-05	6.20E-06	1.33E-02	8.70E-04
Vinyl chloride	7.65E-01	2.09E-02	1.49E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	2.14E-02	1.27E-04	8.32E-06	6.91E-02	4.52E-03

Table A-22
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 50 Tufts St.
Excavation Air
Volatilization from Soil Gas

Receptor:	Construction Worker
Medium of Origin:	Soil Gas
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil Gas mg/m3	Alpha Volatilization from Soil Gas to Excavation Air (mg/m3 excav) / (mg/m3 SG)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic mg/m3	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	NA	9.35E-05	1	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	3.25E-04	1	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	1.25E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	8.89E-05	1	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	8.82E-05	1	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	NA	1.08E-04	1	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Trans-1,2-Dichloroethene	NA	8.63E-05	1	NA	4.6	0.000010	1	NA	NA	1	NA	NA	NA	NA
Trichloroethane, 1,1,1-	NA	8.48E-05	1	NA	0.7	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethene	NA	9.35E-05	1	NA	5.2	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethane, 1,1,1-	NA	9.47E-05	1	NA	0.18	0.0000017	1	NA	NA	1	NA	NA	NA	NA
Vinyl chloride	NA	1.27E-04	1	NA	0.1	0.0000088	1	NA	NA	1	NA	NA	NA	NA
Total									NC			NC	no data	no data

NA - Not available
NC - Not calculated
ND - Not detected

Table A-23

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 50 Tufts St.
Excavation Air
Volatilization from Subsurface Soil

Receptor:	Construction Worker	▼
Medium of Origin:	Subsurface Soil	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
ATc	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATn	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
C	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
	Conversion Factor	ug/mg	1000	

	EPC	VF Volatilization from Subsurface Soil to Excavation Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFIc	ADE-c mg/m3	Riskinh	RAFInc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Compound	Subsurface Soil mg/kg			Excavation Air (mg/m3)										
Carbon tetrachloride	4.8E-02	1.53E-03	1	7.3E-05	0.43	0.000015	1	1E-07	2E-09	1	9E-06	2E-05	2E-09	2E-05
Chloroethane	1.2E-01	5.80E-03	1	7.0E-04	10	NA	NC	NA	NA	1	8E-05	8E-06	NA	8E-06
Chloroform	NA	1.11E-03	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	1.15E-03	1	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	1.17E-03	1	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	2.51E-03	1	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	8.42E-04	1	9.3E-03	4.6	0.000010	1	2E-05	2E-07	1	1E-03	2E-04	2E-07	2E-04
Trans-1,2-Dichloroethene	4.8E-02	1.71E-03	1	8.1E-05	0.7	NA	NC	NA	NA	1	1E-05	1E-05	NA	1E-05
Trichloroethane, 1,1,1-	NA	1.29E-03	1	NA	5.2	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethene	6.4E-02	1.14E-03	1	7.3E-05	0.18	0.0000017	1	1E-07	2E-10	1	9E-06	5E-05	2E-10	5E-05
Vinyl chloride	4.8E-02	4.71E-03	1	2.2E-04	0.1	0.0000088	1	4E-07	3E-09	1	3E-05	3E-04	3E-09	3E-04
Total									2E-07			6E-04	2E-07	6E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-24

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
 50 Tufts Street, Somerville MA
 UniFirst
 Construction Worker at 50 Tufts St.
 Excavation Air
 Volatilization from Groundwater

Receptor:	Construction Worker	▼
Medium of Origin:	Groundwater	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Groundwater (mg/L)	VF Volatilization from Groundwater to Excavation Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Risk _{inh}	RAFinc	ADE-nc mg/m3	H _{linh}	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	1.4E-01	3.91E-02	1	5.3E-03	0.43	0.000015	1	9E-06	1E-07	1	6E-04	1E-03	1E-07	1E-03
Chloroethane	2.5E-01	1.10E-01	1	2.8E-02	10	NA	NC	NA	NA	1	3E-03	3E-04	NA	3E-04
Chloroform	1.3E-01	7.13E-03	1	9.0E-04	0.66	0.000023	1	2E-06	3E-08	1	1E-04	2E-04	3E-08	2E-04
Dichloroethane, 1,1-	1.5E-01	7.86E-03	1	1.2E-03	5	NA	NC	NA	NA	1	1E-04	3E-05	NA	3E-05
Dichloroethene, cis-1,2-	2.2E-01	5.52E-03	1	1.2E-03	0.035	NA	NC	NA	NA	1	1E-04	4E-03	NA	4E-03
Dichloroethene, 1,1-	3.1E+00	4.86E-02	1	1.5E-01	0.2	NA	1	NA	NA	1	2E-02	9E-02	NA	9E-02
Tetrachloroethene	6.2E+01	1.99E-02	1	1.2E+00	4.6	0.000010	1	2E-03	2E-05	1	1E-01	3E-02	2E-05	3E-02
Trans-1,2-Dichloroethene	1.3E-01	1.28E-02	1	1.6E-03	0.7	NA	NC	NA	NA	1	2E-04	3E-04	NA	3E-04
Trichloroethane, 1,1,1-	1.4E+02	2.43E-02	1	3.5E+00	5.2	NA	NC	NA	NA	1	4E-01	8E-02	NA	8E-02
Trichloroethene	1.1E+02	1.33E-02	1	1.5E+00	0.18	0.000017	1	3E-03	4E-06	1	2E-01	1E+00	4E-06	1E+00
Vinyl chloride	1.3E-01	6.91E-02	1	8.7E-03	0.1	0.0000088	1	1E-05	1E-07	1	1E-03	1E-02	1E-07	1E-02
Total									3E-05			1E+00	3E-05	1E+00

NA - Not available

NC - Not calculated

ND - Not detected

Table A-25

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 50 Tufts St.
Excavation Air

Receptor:	Construction Worker	▼
Medium of Origin:		▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

All 3 media

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	.182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Average of 3 media (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	2.7E-03	0.43	0.000015	1	5E-06	7E-08	1	3E-04	7E-04	7E-08	7E-04
Chloroethane	1.4E-02	10	NA	NC	NA	NA	1	2E-03	2E-04	NA	2E-04
Chloroform	9.0E-04	0.66	0.000023	1	2E-06	3E-08	1	1E-04	2E-04	3E-08	2E-04
Dichloroethane, 1,1-	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	6.2E-01	4.6	0.000010	1	1E-03	1E-05	1	7E-02	2E-02	1E-05	2E-02
Trans-1,2-Dichloroethene	8.5E-04	0.7	NA	NC	NA	NA	1	1E-04	1E-04	NA	1E-04
Trichloroethane, 1,1,1-	3.5E+00	5.2	NA	NC	NA	NA	1	4E-01	8E-02	NA	8E-02
Trichloroethene	7.4E-01	0.18	0.0000017	1	1E-03	2E-06	1	9E-02	5E-01	2E-06	5E-01
Vinyl chloride	4.4E-03	0.1	0.0000088	1	8E-06	7E-08	1	5E-04	5E-03	7E-08	5E-03
Total						1E-05			6E-01	1E-05	6E-01

NA - Not available
NC - Not calculated
ND - Not detected

Table A-26
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Soil - Dermal contact & Incidental Ingestion
0-6 feet

Receptor:	Utility Worker
Medium:	Surface Soil
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.29	
EF	Soil Exposure Frequency	d/y	1	
EP	Soil Exposure Period - Cancer	y	5	
EP	Soil Exposure Period - Non-Cancer	y	5	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	1825	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Hlder	Total Risk (Soil)	HI (Soil)
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling			
Carbon tetrachloride	4.8E-02	0.007	0.13	1	2E-11	2E-12	1	2E-10	3E-08	3E-08	4E-12	6E-08
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	6E-10	1E-09	1E-09	NA	3E-09
Chloroform	NA	0.01	NA	NA	NA	NA	1	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	1	NA	NC	NA	NA	1.3	NA	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	0.1	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	0.05	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	0.1	0.051	1	4E-09	2E-10	1	5E-08	5E-07	5E-07	4E-10	1E-06
Trans-1,2-Dichloroethene	4.8E-02	0.2	NA	NC	NA	NA	1	2E-10	1E-09	1E-09	NA	2E-09
Trichloroethane, 1,1,1-	NA	0.9	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Trichloroethene	6.4E-02	0.02	0.011	1	2E-11	2E-13	1	3E-10	2E-08	2E-08	5E-13	3E-08
Vinyl chloride	4.8E-02	0.003	1.4	1.53	2E-11	3E-11	1	2E-10	8E-08	8E-08	7E-11	2E-07
Total						2E-10			6E-07	7E-07	5E-10	1E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-27
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Utility Worker at 50 Tufts St.
Ambient Air
Trench
0-6 feet

Receptor:	Utility Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRair TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-yr/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	1	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	5	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	1825	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil Trench 0-6 feet (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFIc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.8E-02	2.9E-09	0.43	0.000015	0.007	0.13	1	1E-13	5E-13	7E-15	4E-13	5E-14	1	2E-12	7E-12	2E-11	6E-12	8E-10	6E-14	9E-10
Chloroethane	1.2E-01	7.2E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	5E-12	2E-11	2E-12	1E-11	4E-11	NA	4E-11
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	NA	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	NA	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	NA	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	6.7E-07	4.6	0.00001	0.1	0.051	1	3E-11	1E-10	1E-12	1E-10	5E-12	1	5E-10	2E-09	3E-10	1E-09	1E-08	6E-12	1E-08
Trans-1,2-Dichloroethene	4.8E-02	2.9E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	2E-12	7E-12	1E-11	6E-12	3E-11	NA	4E-11
Trichloroethane, 1,1,1-	NA	NA	5.2	NA	0.9	NA	NC	NA	NA	1E-15	6E-13	6E-15	1	3E-12	9E-12	5E-11	8E-12	4E-10	7E-15	4E-10
Trichloroethene	6.4E-02	3.8E-09	0.18	0.0000017	0.02	0.011	1	2E-13	7E-13	4E-15	4E-13	6E-13	1	2E-12	7E-12	7E-11	6E-12	2E-09	6E-13	2E-09
Vinyl chloride	4.8E-02	2.9E-09	0.1	0.0000088	0.003	1.4	1	1E-13	5E-13	1E-12	4E-13	6E-12	1	2E-12	7E-12	5E-10	2E-08	7E-12	7E-12	2E-08
Total																				

NA - Not available
NC - Not calculated
ND - Not detected

Table A-28
Exposure and Risk Estimates Associated With Groundwater Contact
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Groundwater
Trench
0-6 feet

Receptor:	Utility Worker
Medium:	Groundwater
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

$$ADD_{ing} = \frac{C_{gw} \times IR_{gw} \times RAF_{ow} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{gw} \times CF \times SA \times K_p \times ET \times RAF_{dw} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk = ADD_{ing} \times CSF$$

$$Risk = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IR _{gw}	Groundwater Ingestion Rate	L/d	0.01	
SA	Groundwater Dermal Contact Skin Exposed	cm ²	817	
EF	Groundwater Exposure Frequency	d/y	1	
EP	Groundwater Exposure Period - Cancer	y	5	
EP	Groundwater Exposure Period - Non-Cancer	y	5	
AT _c	Groundwater Averaging Time - Cancer	d	25550	
AT _n	Groundwater Averaging Time - Non-Cancer	d	1825	
ET	Groundwater Dermal Contact Exposure Time	hr/d	2	
BW	Body Weight	kg	58	
CF	Conversion Factor	L/cm ³	1.00E-03	

Compound	EPC Groundwater Trench 0-6 feet (mg/L)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact						Total					
				RAFowc	ADDing-c mg/kg-d	Risking	RAFownc	ADDing-nc mg/kg-d	Hling	Kp (cm/hr)	RAFdwc	ADDder-c mg/kg-d	Riskder	RAFDwnc	ADDder-nc mg/kg-d	Hlder	Risk(GW)	HI(GW)
Carbon tetrachloride	1.4E-01	0.007	0.13	1	5E-09	6E-10	1	6E-08	9E-06	1.6E-02	1	1E-08	2E-09	1	2E-07	2E-05	2E-09	3E-05
Chloroethane	2.5E-01	0.4	NA	NC	NA	NA	1	1E-07	3E-07	6.1E-03	NC	NA	NA	1	1E-07	3E-07	NA	6E-07
Chloroform	1.3E-01	0.01	NA	NC	NA	NA	1	6E-08	6E-06	6.8E-03	NC	NA	NA	1	7E-08	7E-06	NA	1E-05
Dichloroethane,1,1-	1.5E-01	1	NA	NC	NA	NA	1.3	1E-07	1E-07	6.7E-03	NC	NA	NA	1	8E-08	8E-08	NA	2E-07
Dichloroethene, cis-1,2-	2.2E-01	0.1	NA	NC	NA	NA	1	1E-07	1E-06	6.6E-03	NC	NA	NA	1	1E-07	1E-06	NA	2E-06
Dichloroethene, 1,1-	3.1E+00	0.05	NA	NC	NA	NA	1	1E-06	3E-05	4.3E-03	NC	NA	NA	1	1E-06	2E-05	NA	5E-05
Tetrachloroethene	6.2E+01	0.1	0.051	1	2E-06	1E-07	1	3E-05	3E-04	3.3E-02	1	1E-05	6E-07	1	2E-04	2E-03	7E-07	2E-03
Trans-1,2-Dichloroethene	1.3E-01	0.2	NA	NC	NA	NA	1	6E-08	3E-07	1.1E-02	NC	NA	NA	1	1E-07	5E-07	NA	8E-07
Trichloroethane,1,1,1-	1.4E+02	0.9	NA	NC	NA	NA	1	7E-05	8E-05	1.3E-02	NC	NA	NA	1	1E-04	2E-04	NA	2E-04
Trichloroethene	1.1E+02	0.02	0.011	1	4E-06	4E-08	1	5E-05	3E-03	1.2E-02	1	7E-06	8E-08	1	1E-04	5E-03	1E-07	8E-03
Vinyl chloride	1.3E-01	0.003	1.4	1.53	6E-09	9E-09	1	6E-08	2E-05	8.2E-03	1	6E-09	8E-09	1	8E-08	3E-05	2E-08	5E-05
Total						2E-07			3E-03				7E-07			7E-03	8E-07	1E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-29
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H'_{Ts}	Defl Vadose Zone (Layer A + Layer B)	Defl Total (Layer A + Layer B + Layer C)	Deflcrack (Layer A)	Exponent of Peclet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF	Volatilization from Subsurface Soil to Trench Air VF	Volatilization from Soil Gas to Excavation Air Alpha	Volatilization from Soil Gas to Trench Air Alpha	Volatilization from Groundwater to Excavation Air VF	Volatilization from Groundwater to Trench Air VF
Compound	(conc/conc)	(cm2/sec)	(cm2/sec)	(cm2/sec)		(cm3/g)	(mg/m3) / (mg/kg)	(mg/m3) / (mg/kg)	(mg/m3 excav) / (mg/m3 SG)	(mg/m3 trench) / (mg/m3 SG)	(mg/m3) / (mg/L)	(mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	7.49E-03	1.54E-02	1.28E+104	1.5E+02	1.53E-03	5.88E-02	-1.69E-06	3.51E-04	-4.84E-04	1.00E-01
Chloroethane	4.77E-01	5.35E-02	2.60E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.23E-01	-5.88E-06	1.22E-03	-1.36E-03	2.82E-01
Chloroform	8.04E-02	2.05E-02	1.00E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	4.28E-02	-2.26E-06	4.67E-04	-8.84E-05	1.83E-02
Dichloroethane, 1,1-	1.24E-01	1.46E-02	7.13E-03	1.46E-02	2.74E+109	5.3E+01	1.15E-03	4.43E-02	-1.61E-06	3.33E-04	-9.75E-05	2.02E-02
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	7.08E-03	1.45E-02	2.13E+110	3.6E+01	1.17E-03	4.51E-02	-1.60E-06	3.31E-04	-6.85E-05	1.42E-02
Dichloroethene, 1,1-	6.34E-01	1.78E-02	8.64E-03	1.78E-02	1.68E+90	6.5E+01	2.51E-03	9.62E-02	-1.95E-06	4.04E-04	-6.03E-04	1.25E-01
Tetrachloroethene	3.24E-01	1.42E-02	6.91E-03	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.23E-02	-1.56E-06	3.24E-04	-2.47E-04	5.11E-02
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	6.79E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	6.55E-02	-1.53E-06	3.18E-04	-1.59E-04	3.30E-02
Trichloroethane, 1,1,1-	3.68E-01	1.54E-02	7.49E-03	1.54E-02	1.28E+104	1.4E+02	1.29E-03	4.95E-02	-1.69E-06	3.51E-04	-3.01E-04	6.24E-02
Trichloroethene	1.97E-01	1.56E-02	7.59E-03	1.56E-02	6.13E+102	9.4E+01	1.14E-03	4.38E-02	-1.71E-06	3.55E-04	-1.65E-04	3.41E-02
Vinyl chloride	7.65E-01	2.09E-02	1.02E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	1.81E-01	-2.30E-06	4.76E-04	-8.56E-04	1.77E-01

Symbol (units) Parameter Value Comment

L_{crack}	(cm)	Thickness of foundation	15	
f_{oc}	(g/g)	Fraction organic carbon in vadose zone soil	0.02	
L_f	(15 or 200 cm)	Depth below grade to bottom of enclosed space floor	15	Input either 15 or 200
L_{wt}	(cm)	Depth below grade to water table	188	Fl.
T_s	Kelvin	Average soil/ groundwater temperature	283	10 (°C)
L_f	(cm)	Source- building separation	173	DEP Default
W_b	(cm)	Length of building	961	DEP Default
H_b	(cm)	Width of building	488	DEP Default
X_{crack}	(cm)	Height of building	3.84E+03	DEP Default
ER	(1/hr)	Floor- wall searn perimeter	0.45	DEP Default
$Q_{building}$	(cm ³ /s)	Air exchange rate	5.63E+04	
A_g	(cm ²)	Bldg. ventilation rate	9.24E+05	
η	(unitless)	Area of enclosed space below grade	4.16E-04	
Z_{crack}	(cm)	Crack- to-total area ratio	15	
μ_{TS}	(g/cm-s)	Crack depth below grade	1.75E-04	
L_d	(cm)	Vapor viscosity at ave. soil temperature	173	
L_p	(cm)	Diffusion path length	15	
r_{crack}	(cm)	Convection path length	0.10	DEP Default
ΔP	(g/cm-s ²)	Crack radius	40	DEP Default
Q_{soil}	(cm ² /s)	Pressure differential between soil surface and enclosed space	9.45E+01	
A_{crack}	(cm ²)	Average vapor flow rate into bldg.	384	
Rc	(cal/mol-K)	Area of crack	1.99E+00	
R	(atm-m ³ /mol-K)	Gas constant	8.21E-05	
R2	(mmHg-cm ³ /mol-K)	Universal gas constant	6.24E+04	
W_{sa}	(cm)	Width of soil source to ambient air	1.52E+03	50
t_{sa}	(s)	Averaging time for volatilization from soil to ambient air	4.42E+05	0.014
U	(cm/s)	Wind speed	225	y
D	(cm)	Mixing height	183	6
Z_s	(cm)	Depth to soil source	188	6.16
Z_{sg}	(cm)	Depth to soil gas source	188	6.16
W_E	(cm)	Width of excavation	1524	50
L_e	(cm)	Length of excavation	762	25
H_e	(cm)	Height of excavation	457	15
W_{Ec}	(cm)	Width of excavation that is contaminated	1524	50
L_{Ec}	(cm)	Length of excavation that is contaminated	762	25
H_{Ec}	(cm)	Height of excavation that is contaminated	457	15
WT	(cm)	Width of trench	457	15
LT	(cm)	Length of trench	122	4
HT	(cm)	Height of trench	183	6
WTC	(cm)	Width of trench that is contaminated	457	15
LTC	(cm)	Length of trench that is contaminated	122	4
HTC	(cm)	Height of trench that is contaminated	183	6
t_{SE}	(s)	Averaging time for volatilization from soil to excavation	1.58E+07	0.5
t_{ST}	(s)	Averaging time for volatilization from soil to trench	4.42E+05	0.014
F_E	(unitless)	Fraction of wind speed that occurs in excavation	0.5	y
F_T	(unitless)	Fraction of wind speed that occurs in trench	0.1	
d	(cm)	Lower depth of surface soil source	462	15.16

		Vadose Zone Layer A	Vadose Zone Layer B	Capillary Zone
p_b	(g/cm ³)	1.5	1.5	1.5
n	(unitless)	0.43	0.43	4.30E-01
θ_w	(cm ³ /cm ³)	0.06	0.06	2.53E-01
θ_a	(cm ³ /cm ³)	0.37	0.37	1.77E-01
h	(cm)	15	141	1.70E+01
S_{se}	(cm ² /cm ³)			1.86E-02
k_i	(cm ²)			9.92E-08
k_r	(cm ²)			9.87E-01
k_v	(cm ²)			9.79E-08

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building Sand

Capillary zone Sand

Key:

Type In Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Table A-31
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Trench Air
Volatilization from Soil Gas

Receptor:	Utility Worker
Medium of Origin:	Soil Gas
Exposure Medium:	Trench Air
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil Gas mg/m3	Alpha Volatilization from Soil Gas to Trench Air (mg/m3 trench) / (mg/m3 SG)	Source Dilution Factor	EPC Trench Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic mg/m3	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	NA	3.51E-04	1	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	1.22E-03	1	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	4.67E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	3.33E-04	1	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, cis-1,2-	NA	3.31E-04	1	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	4.04E-04	1	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	NA	3.24E-04	1	NA	4.6	0.00001	1	NA	NA	1	NA	NA	NA	NA
Trans-1,2-Dichloroethene	NA	3.18E-04	1	NA	0.7	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethane, 1,1,1-	NA	3.51E-04	1	NA	5.2	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethene	NA	3.55E-04	1	NA	0.18	0.000017	1	NA	NA	1	NA	NA	NA	NA
Vinyl chloride	NA	4.76E-04	1	NA	0.1	0.0000088	1	NA	NA	1	NA	NA	NA	NA
Total									NC			NC	no data	no data

NA - Not available
NC - Not calculated
ND - Not detected

Table A-32
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Trench Air
Volatilization from Subsurface Soil

$$C_{air} = \frac{C_{soil} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Receptor:	Utility Worker
Medium of Origin:	Subsurface Soil
Exposure Medium:	Trench Air
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	VF	Source Dilution Factor	EPC	RfC	URF	RAFc	ADE-c	Risk _{inh}	RAFinh	ADE-nc	H _{inh}	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	4.8E-02	5.88E-02	1	2.8E-03	0.43	0.000015	1	2E-07	3E-09	1	3E-06	6E-06	3E-09	6E-06
Chloroethane	1.2E-01	2.23E-01	1	2.7E-02	10	NA	NC	NA	NA	1	2E-05	2E-06	NA	2E-06
Chloroform	NA	4.28E-02	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	4.43E-02	1	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	4.51E-02	1	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, 1,1-	NA	9.62E-02	1	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	1.1E+01	3.23E-02	1	3.6E-01	4.6	0.00001	1	2E-05	2E-07	1	3E-04	7E-05	2E-07	7E-05
Trans-1,2-Dichloroethene	4.8E-02	6.55E-02	1	3.1E-03	0.7	NA	NC	NA	NA	1	3E-06	4E-06	NA	4E-06
Trichloroethane, 1,1,1-	NA	4.95E-02	1	NA	5.2	NA	NC	NA	NA	1	NA	NA	NA	NA
Trichloroethene	6.4E-02	4.38E-02	1	2.8E-03	0.18	0.0000017	1	2E-07	3E-10	1	3E-06	1E-05	3E-10	1E-05
Vinyl chloride	4.8E-02	1.81E-01	1	8.6E-03	0.1	0.0000088	1	6E-07	5E-09	1	8E-06	8E-05	5E-09	8E-05
Total									2E-07			2E-04	2E-07	2E-04

NA - Not available
NC - Not calculated
ND - Not detected

utility 50 Tufts.xls - utilityVOLtoEXC(soil)

Table A-33
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Trench Air
Volatilization from Groundwater

Receptor:	Utility Worker
Medium of Origin:	Groundwater
Exposure Medium:	Trench Air
Exposure Area:	Trench
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Groundwater (mg/L)	VF Volatilization from Groundwater to Trench Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC		URF	RAFiC		ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk	
				Trench Air (mg/m3)	RfC (mg/m3)									(Trench Air)	HI (Trench Air)
Carbon tetrachloride	1.4E-01	1.00E-01	1	1.4E-02	0.43	0.000015	1	9E-07	1E-08	1	1	1E-05	3E-05	1E-08	3E-05
Chloroethane	2.5E-01	2.82E-01	1	7.1E-02	10	NA	NC	NA	NA	1	1	6E-05	6E-06	NA	6E-06
Chloroform	1.3E-01	1.83E-02	1	2.3E-03	0.66	0.000023	1	2E-07	3E-09	1	1	2E-06	3E-06	3E-09	3E-06
Dichloroethane, 1,1-	1.5E-01	2.02E-02	1	3.1E-03	5	NA	NC	NA	NA	1	1	3E-06	6E-07	NA	6E-07
Dichloroethane, cis-1,2-	2.2E-01	1.42E-02	1	3.2E-03	0.035	NA	NC	NA	NA	1	1	3E-06	8E-05	NA	8E-05
Dichloroethane, 1,1-	3.1E+00	1.25E-01	1	3.8E-01	0.2	NA	1	NA	NA	1	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	6.2E+01	5.11E-02	1	3.2E+00	4.6	0.00001	1	2E-04	2E-06	1	1	3E-03	6E-04	2E-06	6E-04
Trans-1,2-Dichloroethene	1.3E-01	3.30E-02	1	4.1E-03	0.7	NA	NC	NA	NA	1	1	4E-06	5E-06	NA	5E-06
Trichloroethane, 1,1,1-	1.4E+02	6.24E-02	1	8.9E+00	5.2	NA	NC	NA	NA	1	1	8E-03	2E-03	NA	2E-03
Trichloroethene	1.1E+02	3.41E-02	1	3.8E+00	0.18	0.000017	1	2E-04	4E-07	1	1	3E-03	2E-02	4E-07	2E-02
Vinyl chloride	1.3E-01	1.77E-01	1	2.2E-02	0.1	0.0000088	1	1E-06	1E-08	1	1	2E-05	2E-04	1E-08	2E-04
Total									3E-06				2E-02	3E-06	2E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-34
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker at 50 Tufts St.
Trench Air

Receptor:	Utility Worker	▼
Medium of Origin:		▼ All 3 media
Exposure Medium:	Trench Air	▼
Exposure Area:	Trench	▼
Depth:	0-6 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{surface} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	8.2E-03	0.43	0.000015	1	5E-07	8E-09	1	8E-06	2E-05	8E-09	2E-05
Chloroethane	4.9E-02	10	NA	NC	NA	NA	1	4E-05	4E-06	NA	4E-06
Chloroform	2.3E-03	0.66	0.000023	1	2E-07	3E-09	1	2E-06	3E-06	3E-09	3E-06
Dichloroethane, 1,1-	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	1.8E+00	4.6	0.00001	1	1E-04	1E-06	1	2E-03	4E-04	1E-06	4E-04
Trans-1,2-Dichloroethene	3.6E-03	0.7	NA	NC	NA	NA	1	3E-06	5E-06	NA	5E-06
Trichloroethane, 1,1,1-	8.9E+00	5.2	NA	NC	NA	NA	1	8E-03	2E-03	NA	2E-03
Trichloroethene	1.9E+00	0.18	0.0000017	1	1E-04	2E-07	1	2E-03	1E-02	2E-07	1E-02
Vinyl chloride	1.5E-02	0.1	0.0000088	1	1E-06	9E-09	1	1E-05	1E-04	9E-09	1E-04
Total						1E-06			1E-02	1E-06	1E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-35

Exposure and Risk Estimates Associated With Soil Contact

50 Tufts Street, Somerville MA

UniFirst

Resident at 60 Tufts St.

Soil

Receptor:	Resident
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{os} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CSF$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-ci	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPc	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsnc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride Chloroethane Chloroform Dichloroethane, 1,1- Dichloroethane, cis-1,2- Dichloroethane, 1,1- Tetrachloroethene Trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride	4.8E-02	0.0007	0.13	1	2E-08	2E-09	1	1E-07	2E-04	0.1	2E-08	2E-09	0.1	1E-07	1E-04	5E-09	3E-04
	1.2E-01	0.4	NA	NC	NA	NA	1	3E-07	7E-07	NC	NA	NA	0.1	2E-07	6E-07	NA	1E-06
	NA	0.01	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
	4.8E-02	0.1	NA	NC	NA	NA	1.3	1E-07	1E-06	NC	NA	NA	0.13	1E-07	1E-06	NA	3E-06
	4.8E-02	0.01	NA	NC	NA	NA	1	1E-07	1E-05	NC	NA	NA	0.1	1E-07	1E-05	NA	2E-05
	4.8E-02	0.05	NA	NC	NA	NA	1	1E-07	2E-06	NC	NA	NA	0.1	1E-07	2E-06	NA	4E-06
	1.8E-01	0.01	0.051	1	7E-08	3E-09	1	4E-07	4E-05	0.1	7E-08	4E-09	0.1	4E-07	4E-05	7E-09	8E-05
	4.8E-02	0.02	NA	NC	NA	NA	1	1E-07	6E-06	NC	NA	NA	0.1	1E-07	5E-06	NA	1E-05
	4.8E-02	0.09	NA	NC	NA	NA	1	1E-07	1E-06	NC	NA	NA	0.1	1E-07	1E-06	NA	2E-06
	3.4E-02	0.002	0.011	1	1E-08	1E-10	1	8E-08	4E-05	0.1	1E-08	1E-10	0.1	7E-08	4E-05	3E-10	8E-05
4.8E-02	0.003	1.4	1.53	3E-08	4E-08	1	1E-07	4E-05	0.16	3E-08	4E-08	0.1	1E-07	3E-05	8E-08	7E-05	
Total						4E-08			3E-04			5E-08		3E-04		9E-08	6E-04

NA - Not available

NC - Not calculated

ND - Not detected

Table A.36
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Resident at 60 Tufts St
Ambient Air

Receptor:	Resident
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Units	Value	Comment
IRair	m3/hr	0.4	
IRairTWA	m3-y/h-kg	0.6	
PEF	ug/m3	32	
ET	hr/d	8	
EF	d/y	150	
EP	y	30	
EP	y	7	
ATc	d	25550	
ATn	d	2555	
BW	kg	17	
C	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$

$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

	EPC	EPC	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhinc mg/kg-d	ADE-inc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Compound		Fugitive Dust (mg/m3)																		
Carbon tetrachloride	4.8E-02	1.5E-09	0.43	0.000015	0.0007	0.13	1	2E-11	7E-11	1E-12	9E-11	1E-11	1	5E-11	2E-10	4E-10	2E-10	2E-07	2E-07	
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	5E-11	4E-10	1E-09	1E-09	
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	
Dichloroethane, 1,1-	4.8E-02	1.5E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	4E-10	2E-10	2E-09	2E-09	
Dichloroethane, cis-1,2-	4.8E-02	1.5E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	5E-09	2E-10	2E-08	2E-08	
Dichloroethane, 1,1-	4.8E-02	1.5E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	5E-11	2E-10	9E-10	2E-10	3E-09	4E-09	
Tetrachloroethene	1.8E-01	5.7E-09	4.6	0.00001	0.01	0.051	1	8E-11	3E-10	3E-12	3E-10	2E-11	1	2E-10	7E-10	2E-10	6E-10	6E-08	6E-08	
Trans-1,2-Dichloroethane	4.8E-02	1.5E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	3E-09	2E-10	8E-09	1E-08	
Trichloroethane, 1,1,1-	4.8E-02	1.5E-09	5.2	NA	0.09	NA	NC	NA	NA	9E-14	6E-11	7E-13	1	4E-11	1E-10	7E-10	1E-10	6E-08	6E-08	
Trichloroethene	3.4E-02	1.1E-09	0.18	0.0000017	0.002	0.011	1	2E-11	5E-11	7E-13	9E-11	1E-10	1	5E-11	2E-10	2E-09	2E-10	5E-08	5E-08	
Vinyl chloride	4.8E-02	1.5E-09	0.1	0.0000088	0.003	1.4	1	2E-11	7E-11	5E-12	9E-11	1E-10	1	5E-11	2E-10	2E-09	2E-10	2E-10	4E-07	
Total												1E-10				1E-08		4E-07		

NA - Not available
NC - Not calculated
ND - Not detected

Table A-37
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Resident at 60 Tufts St.
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	1.4E-03	4.6	0.00001	1	8E-05	8E-07	1	2E-04	4E-05	8E-07	4E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane, 1,1,1-	6.2E-04	5.2	NA	NC	NA	NA	1	9E-05	2E-05	NA	2E-05
Trichloroethene	5.8E-04	0.18	0.0000017	1	3E-05	6E-08	1	8E-05	4E-04	6E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						1E-06			4E-03	1E-06	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-38
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at 60 Tufts St.
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	50	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPc	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os}}{AP \times BW} \times EF \times EP$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFdsnc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	4.8E-02	0.0007	0.13	1	5E-09	6E-10	1	1E-08	2E-05	0.1	1E-09	1E-10	0.1	3E-09	4E-06	8E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-08	8E-08	NC	NA	NA	0.1	7E-09	2E-08	NA	1E-07
Chloroform	NA	0.01	NA	NC	NA	NA	1	NA	NA	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.8E-02	0.1	NA	NC	NA	NA	1.3	2E-08	2E-07	NC	NA	NA	0.13	3E-09	3E-08	NA	2E-07
Dichloroethene, cis-1,2-	4.8E-02	0.01	NA	NC	NA	NA	1	1E-08	1E-06	NC	NA	NA	0.1	3E-09	3E-07	NA	2E-06
Dichloroethene, 1,1-	4.8E-02	0.05	NA	NC	NA	NA	1	1E-08	3E-07	NC	NA	NA	0.1	3E-09	5E-08	NA	3E-07
Tetrachloroethene	1.8E-01	0.01	0.051	1	2E-08	9E-10	1	5E-08	5E-06	0.1	4E-09	2E-10	0.1	1E-08	1E-06	1E-09	6E-06
Trans-1,2-Dichloroethene	4.8E-02	0.02	NA	NC	NA	NA	1	1E-08	6E-07	NC	NA	NA	0.1	3E-09	1E-07	NA	8E-07
Trichloroethane, 1,1,1-	4.8E-02	0.09	NA	NC	NA	NA	1	1E-08	1E-07	NC	NA	NA	0.1	3E-09	3E-08	NA	2E-07
Trichloroethene	3.4E-02	0.002	0.011	1	4E-09	4E-11	1	9E-09	5E-06	0.1	7E-10	8E-12	0.1	2E-09	1E-06	5E-11	6E-06
Vinyl chloride	4.8E-02	0.003	1.4	1.53	8E-09	1E-08	1	1E-08	4E-06	0.16	2E-09	2E-09	0.1	3E-09	9E-07	1E-08	5E-06
Total						1E-08			3E-05			3E-09			7E-06	1E-08	4E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-39
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Commercial Worker at 60 Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRair TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFIre	ADD-inhc mg/kg-d	ADE-nc mg/m3	HIinh	ADD-ingnc	HIing	Risk (Particulates in Air) YC-OC-A	Hi (Particulates in Air) YC
Carbon tetrachloride	4.8E-02	1.5E-09	0.43	0.000015	0.0007	0.13	1	2E-11	5E-11	8E-13	5E-11	6E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	7E-12	2E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	3E-10	3E-11	3E-10	7E-10	NA	8E-10
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	4.8E-02	1.5E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	3E-10	1E-10	1E-09	NA	1E-09
Dichloroethane, cis-1,2-	4.8E-02	1.5E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	4E-09	1E-10	1E-08	NA	2E-08
Dichloroethene, 1,1-	4.8E-02	1.5E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	4E-11	1E-10	7E-10	1E-10	2E-09	NA	3E-09
Tetrachloroethene	1.8E-01	5.7E-09	4.6	0.00001	0.01	0.051	1	6E-11	2E-10	2E-12	2E-10	9E-12	1	1E-10	5E-10	1E-10	4E-10	4E-08	1E-11	4E-08
Trans-1,2-Dichloroethene	4.8E-02	1.5E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	NA	8E-09
Trichloroethane, 1,1,1-	4.8E-02	1.5E-09	5.2	NA	0.09	NA	1	1E-11	4E-11	7E-14	3E-11	4E-13	1	3E-11	1E-10	3E-11	1E-10	1E-09	NA	1E-09
Trichloroethene	3.4E-02	1.1E-09	0.18	0.0000017	0.002	0.011	1	2E-11	5E-11	5E-13	5E-11	6E-11	1	4E-11	1E-10	6E-10	9E-11	4E-08	4E-13	4E-08
Vinyl chloride	4.8E-02	1.5E-09	0.1	0.0000088	0.003	1.4	1	2E-11	5E-11	3E-12	5E-11	8E-11	1	4E-11	1E-10	1E-09	1E-10	4E-08	6E-11	4E-08
Total																9E-09		3E-07		3E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-40
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at 60 Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinch	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-05	9E-05	NA	9E-05
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-05	1E-03	NA	1E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-05	2E-04	NA	2E-04
Tetrachloroethene	1.4E-03	4.6	0.00001	1	6E-05	6E-07	1	2E-04	3E-05	6E-07	3E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-05	6E-04	NA	6E-04
Trichloroethane, 1,1,1-	6.2E-04	5.2	NA	NC	NA	NA	1	7E-05	1E-05	NA	1E-05
Trichloroethene	5.8E-04	0.18	0.0000017	1	2E-05	4E-08	1	6E-05	4E-04	4E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	9E-08	1	3E-05	3E-04	9E-08	3E-04
Total						7E-07			3E-03	7E-07	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-41
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Soil - Dermal contact & Incidental Ingestion

Receptor:	Construction Worker
Medium:	Surface Soil
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.29	
EF	Soil Exposure Frequency	d/y	130	
EP	Soil Exposure Period - Cancer	y	1	
EP	Soil Exposure Period - Non-Cancer	y	1	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	182	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total					
				RAFosc	ADDing-c mg/kg-d	Risking	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdscnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil)	HI (Soil)	
Carbon tetrachloride	4.8E-02	0.007	0.13	1	4E-10	5E-11	1	0.1	4E-10	5E-11	0.1	6E-08	8E-06	1E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	NC	NA	NA	0.1	1E-07	4E-07	NA	7E-07
Chloroform	NA	0.01	NA	NA	NA	NA	1	NA	NA	NA	0.1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.8E-02	1	NA	NC	NA	NA	1.3	NC	NA	NA	0.13	8E-08	8E-08	NA	2E-07
Dichloroethene, cis-1,2-	4.8E-02	0.1	NA	NC	NA	NA	1	NC	NA	NA	0.1	6E-08	6E-07	NA	1E-06
Dichloroethene, 1,1-	4.8E-02	0.05	NA	NC	NA	NA	1	NC	NA	NA	0.1	6E-08	1E-06	NA	2E-06
Tetrachloroethene	1.8E-01	0.1	0.051	1	2E-09	8E-11	1	0.1	2E-09	8E-11	0.1	2E-07	2E-06	2E-10	4E-06
Trans-1,2-Dichloroethene	4.8E-02	0.2	NA	NC	NA	NA	1	NC	NA	NA	0.1	6E-08	3E-07	NA	6E-07
Trichloroethane, 1,1,1- ^a	4.8E-02	0.9	NA	NC	NA	NA	1	NC	NA	NA	0.1	6E-08	7E-08	NA	1E-07
Trichloroethene	3.4E-02	0.02	0.011	1	3E-10	3E-12	1	0.1	3E-10	3E-12	0.1	4E-08	2E-06	7E-12	4E-06
Vinyl chloride	4.8E-02	0.003	1.4	1.53	6E-10	9E-10	1	0.16	7E-10	9E-10	0.1	6E-08	2E-05	2E-09	4E-05
Total						1E-09				1E-09			3E-05	2E-09	7E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-42
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Ambient Air

Receptor:	Construction Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.00	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	130	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	182	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	R/C (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-inhc mg/kg-d	ADE-c mg/m3	RiskInh	ADD-ingc	RiskIng	RAFinc	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.8E-02	2.9E-09	0.43	0.000015	0.007	0.13	1	4E-12	1E-11	2E-13	1E-11	1E-12	1	5E-10	2E-09	4E-09	2E-09	2E-07	2E-12	2E-07
Chloroethane	1.2E-01	7.2E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-09	4E-09	4E-10	4E-09	1E-08	NA	1E-08
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	4.8E-02	2.9E-09	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	5E-10	2E-09	4E-10	2E-09	2E-09	NA	2E-09
Dichloroethene, cis-1,2-	4.8E-02	2.9E-09	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	5E-10	2E-09	5E-08	2E-09	2E-08	NA	7E-08
Dichloroethene, 1,1-	4.8E-02	2.9E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	5E-10	2E-09	9E-09	2E-09	3E-08	NA	4E-08
Tetrachloroethene	1.8E-01	1.1E-08	4.6	0.00001	0.1	0.051	1	1E-11	5E-11	5E-13	4E-11	2E-12	1	2E-09	7E-09	1E-09	6E-09	6E-08	3E-12	6E-08
Trans-1,2-Dichloroethene	4.8E-02	2.9E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	5E-10	2E-09	3E-09	2E-09	8E-09	NA	1E-08
Trichloroethane, 1,1,1-	4.8E-02	2.9E-09	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	NA	1	5E-10	2E-09	3E-10	2E-09	2E-09	NA	2E-09
Trichloroethene	3.4E-02	2.1E-09	0.18	0.0000017	0.02	0.011	1	3E-12	9E-12	2E-14	8E-12	9E-14	1	4E-10	1E-09	7E-09	1E-09	5E-08	1E-13	6E-08
Vinyl chloride	4.8E-02	2.9E-09	0.1	0.0000088	0.003	1.4	1	4E-12	1E-11	1E-13	1E-11	2E-11	1	5E-10	2E-09	2E-08	2E-09	5E-07	2E-11	5E-07
Total										8E-13		2E-11				9E-08		9E-07	2E-11	1E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-43
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H'_{TS}	Deff Vadose Zone (Layer A + Layer B)	Deff Total (Layer A + Layer B + Layer C)	Deffcrack (Layer A)	Exponent of Pecllet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.5E+02	1.53E-03	6.95E-03	9.35E-05	6.13E-06	3.91E-02	2.56E-03
Chloroethane	4.77E-01	5.35E-02	3.80E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.64E-02	3.25E-04	2.13E-05	1.10E-01	7.21E-03
Chloroform	8.04E-02	2.05E-02	1.46E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	5.06E-03	1.25E-04	8.17E-06	7.13E-03	4.67E-04
Dichloroethane, 1,1-	1.24E-01	1.46E-02	1.04E-02	1.46E-02	2.74E+109	5.3E+01	1.15E-03	5.25E-03	8.89E-05	5.83E-06	7.86E-03	5.15E-04
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	1.03E-02	1.45E-02	2.13E+110	3.6E+01	1.17E-03	5.34E-03	8.82E-05	5.78E-06	5.52E-03	3.62E-04
Dichloroethene, 1,1-	6.34E-01	1.78E-02	1.26E-02	1.78E-02	1.68E+90	6.5E+01	2.51E-03	1.14E-02	1.08E-04	7.07E-06	4.86E-02	3.18E-03
Tetrachloroethene	3.24E-01	1.42E-02	1.01E-02	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.83E-03	8.63E-05	5.65E-06	1.99E-02	1.30E-03
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	9.91E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	7.75E-03	8.48E-05	5.55E-06	1.28E-02	8.42E-04
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.4E+02	1.29E-03	5.85E-03	9.35E-05	6.13E-06	2.43E-02	1.59E-03
Trichloroethene	1.97E-01	1.56E-02	1.11E-02	1.56E-02	6.13E+102	9.4E+01	1.14E-03	5.18E-03	9.47E-05	6.20E-06	1.33E-02	8.70E-04
Vinyl chloride	7.65E-01	2.09E-02	1.49E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	2.14E-02	1.27E-04	8.32E-06	6.91E-02	4.52E-03

Table A-44
Site-specific Parameters for Volatilization Calculations
50 Tufts Street, Somerville MA
Unifirst
Construction Worker at 60 Tufts St

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building Sand

Capillary zone Sand

Key:

Type In Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Value Comment

L _{rock}	(cm)	15	
f _{oc}	(g/g)	0.02	
L _f	(15 or 200 cm)	15	Input either 15 or 200
L _{wt}	(cm)	462	15.16 Ft.
T _g	Kelvin	283	10 (°C)
L ₁	(cm)	447	
L _g	(cm)	961	DEP Default
W _g	(cm)	961	DEP Default
H _g	(cm)	488	DEP Default
X _{crack}	(cm)	3844	
ER	(1/hr)	0.45	DEP Default
Q _{building}	(cm ³ /s)	5.63E+04	
A _g	(cm ²)	9.24E+05	
η	(unitless)	4.16E-04	
Z _{crack}	(cm)	15	
μ _{1g}	(g/cm-s)	1.75E-04	
L _d	(cm)	4.47E+02	
L _p	(cm)	15	
r _{crack}	(cm)	0.10	DEP Default
ΔP	g/cm-s ²	40	DEP Default
O _{soil}	(cm ³ /s)	9.45E+01	
A _{crack}	(cm ²)	384	
Rc	(cal/mol-K)	1.99E+00	
R	(atm-m3/mol-K)	8.21E-05	
R2	(mmHg-cm3/mol-K)	6.24E+04	
W _{SA}	(cm)	1.52E+03	50 Ft.
t _{SA}	(s)	1.56E+07	0.5 y
U	(cm/s)	225	
D	(cm/s)	183	6 Ft.
Z _s	(cm)	462	15.16 Ft.
Z _{sg}	(cm)	462	15.16 Ft.
W _E	(cm)	1.52E+03	50 Ft.
L _E	(cm)	762	25 Ft.
H _E	(cm)	457	15 Ft.
W _{Ec}	(cm)	1524	50 Ft.
L _{Ec}	(cm)	762	25 Ft.
H _{Ec}	(cm)	457	15 Ft.
WT	(cm)	457	15 Ft.
LT	(cm)	122	4 Ft.
HT	(cm)	183	6 Ft.
W _{Tc}	(cm)	457	15 Ft.
L _{Tc}	(cm)	122	4 Ft.
H _{Tc}	(cm)	183	6 Ft.
t _{SE}	(s)	1.56E+07	0.5 y
t _{ST}	(s)	3.15E+07	1 y
F _E	(unitless)	0.5	
F _T	(unitless)	0.1	
d	(cm)	462	15.16 Ft.

	Vadose Zone Layer A	Vadose Zone Layer B	Capillary Zone
ρ _b	1.5	1.5	1.5
n	0.43	0.43	4.30E-01
θ _w	0.06	0.06	2.53E-01
θ _a	0.37	0.37	1.77E-01
h	15	415	1.70E+01
S _{se}			1.86E-02
k _i			9.92E-08
k _{sp}			9.87E-01
k _v			9.79E-08

Table A-45
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Excavation Air
Volatilization from Soil Gas

Receptor:	Construction Worker
Medium of Origin:	Soil Gas
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil Gas mg/m3	Alpha Volatilization from Soil Gas to Excavation Air (mg/m3 excav) / (mg/m3 SG)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFc	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	8.6E-03	9.35E-05	1	8.0E-07	0.43	0.000015	1	1E-09	2E-11	1	9E-08	2E-07	2E-11	2E-07
Chloroethane	4.1E-03	3.25E-04	1	1.3E-06	10	NA	NC	NA	NA	1	2E-07	2E-08	NA	2E-08
Chloroform	NA	1.25E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	1.1E-02	8.89E-05	1	9.6E-07	5	NA	NC	NA	NA	1	1E-07	2E-08	NA	2E-08
Dichloroethene, cis-1,2-	8.0E-03	8.82E-05	1	7.0E-07	0.035	NA	NC	NA	NA	1	8E-08	2E-06	NA	2E-06
Dichloroethene, 1,1-	1.3E-01	1.08E-04	1	1.4E-05	0.2	NA	1	NA	NA	1	2E-06	8E-06	NA	8E-06
Tetrachloroethene	6.0E+00	8.63E-05	1	5.2E-04	4.6	0.00001	1	9E-07	9E-09	1	6E-05	1E-05	9E-09	1E-05
Trans-1,2-Dichloroethene	5.5E-03	8.48E-05	1	4.6E-07	0.7	NA	NC	NA	NA	1	5E-08	8E-08	NA	8E-08
Trichloroethane, 1,1,1-	1.2E+00	9.35E-05	1	1.1E-04	5.2	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Trichloroethene	1.2E+00	9.47E-05	1	1.1E-04	0.18	0.000017	1	2E-07	3E-10	1	1E-05	7E-05	3E-10	7E-05
Vinyl chloride	3.6E-03	1.27E-04	1	4.6E-07	0.1	0.0000088	1	8E-10	7E-12	1	5E-08	5E-07	7E-12	5E-07
Total									9E-09			1E-04	9E-09	1E-04

NA - Not available
NC - Not calculated
ND - Not detected
juneupdate_construction 60 tufts.xls - construct\VOLtoEXC(soil gas)

Table A-46
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Excavation Air
Volatilization from Subsurface Soil

Receptor:	Construction Worker
Medium of Origin:	Subsurface Soil
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Subsurface Soil mg/kg	VF Volatilization from Subsurface Soil to Excavation Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFc	ADE-c mg/m3	Riskinh	RAFinh	ADE-nc mg/m3	Hlinh	Risk (Trench Air) HI (Trench Air)
Carbon tetrachloride	4.8E-02	1.53E-03	1	7.3E-05	0.43	0.000015	1	1E-07	2E-09	1	9E-06	2E-05	2E-09
Chloroethane	1.2E-01	5.80E-03	1	7.0E-04	10	NA	NC	NA	NA	1	8E-05	8E-06	NA
Chloroform	NA	1.11E-03	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA
Dichloroethane, 1,1-	4.8E-02	1.15E-03	1	5.5E-05	5	NA	NC	NA	NA	1	7E-06	1E-06	NA
Dichloroethene, cis-1,2-	4.8E-02	1.17E-03	1	5.6E-05	0.035	NA	NC	NA	NA	1	7E-06	2E-04	NA
Dichloroethene, 1,1-	4.8E-02	2.51E-03	1	1.2E-04	0.2	NA	1	NA	NA	1	1E-05	7E-05	NA
Tetrachloroethene	1.8E-01	8.42E-04	1	1.5E-04	4.6	0.00001	1	3E-07	3E-09	1	2E-05	4E-06	3E-09
Trans-1,2-Dichloroethene	4.8E-02	1.71E-03	1	8.1E-05	0.7	NA	NC	NA	NA	1	1E-05	1E-05	NA
Trichloroethane, 1,1,1-	4.8E-02	1.29E-03	1	6.1E-05	5.2	NA	NC	NA	NA	1	7E-06	1E-06	NA
Trichloroethene	3.4E-02	1.14E-03	1	3.9E-05	0.18	0.000017	1	7E-08	1E-10	1	5E-06	3E-05	1E-10
Vinyl chloride	4.8E-02	4.71E-03	1	2.2E-04	0.1	0.000088	1	4E-07	3E-09	1	3E-05	3E-04	3E-09
Total									8E-09			6E-04	8E-09
													6E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-47
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Excavation Air
Volatilization from Groundwater

Receptor:	Construction Worker	▼
Medium of Origin:	Groundwater	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC (mg/L)	VF Volatilization from Groundwater to Excavation Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Risk _{inh}	RAFiC	ADE-nc mg/m3	H _{linh}	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	5.0E-04	3.91E-02	1	2.0E-05	0.43	0.000015	1	3E-08	5E-10	1	2E-06	5E-06	5E-10	5E-06
Chloroethane	1.0E-03	1.10E-01	1	1.1E-04	10	NA	NC	NA	NA	1	1E-05	1E-06	NA	1E-06
Chloroform	5.0E-04	7.13E-03	1	3.6E-06	0.66	0.000023	1	6E-09	1E-10	1	4E-07	6E-07	1E-10	6E-07
Dichloroethane, 1,1-	4.9E-04	7.86E-03	1	3.8E-06	5	NA	NC	NA	NA	1	5E-07	9E-08	NA	9E-08
Dichloroethene, cis-1,2-	5.0E-04	5.52E-03	1	2.8E-06	0.035	NA	NC	NA	NA	1	3E-07	9E-06	NA	9E-06
Dichloroethene, 1,1-	4.2E-03	4.86E-02	1	2.0E-04	0.2	NA	1	NA	NA	1	2E-05	1E-04	NA	1E-04
Tetrachloroethene	2.9E-02	1.99E-02	1	5.8E-04	4.6	0.00001	1	1E-06	1E-08	1	7E-05	1E-05	1E-08	1E-05
Trans-1,2-Dichloroethene	5.0E-04	1.28E-02	1	6.4E-06	0.7	NA	NC	NA	NA	1	8E-07	1E-06	NA	1E-06
Trichloroethene, 1,1,1-	1.8E-02	2.43E-02	1	4.3E-04	5.2	NA	NC	NA	NA	1	5E-05	1E-05	NA	1E-05
Trichloroethane	6.0E-03	1.33E-02	1	8.0E-05	0.18	0.000017	1	1E-07	2E-10	1	1E-05	5E-05	2E-10	5E-05
Vinyl chloride	5.0E-04	6.91E-02	1	3.5E-05	0.1	0.0000088	1	6E-08	5E-10	1	4E-06	4E-05	5E-10	4E-05
Total									1E-08			3E-04	1E-08	3E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-48
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at 60 Tufts St.
Excavation Air

Receptor:	Construction Worker	▼
Medium of Origin:		▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	3.1E-05	0.43	0.000015	1	5E-08	8E-10	1	4E-06	9E-06	8E-10	9E-06
Chloroethane	2.7E-04	10	NA	NC	NA	NA	1	3E-05	3E-06	NA	3E-06
Chloroform	3.6E-06	0.66	0.000023	1	6E-09	1E-10	1	4E-07	6E-07	1E-10	6E-07
Dichloroethane, 1,1-	2.0E-05	5	NA	NC	NA	NA	1	2E-06	5E-07	NA	5E-07
Dichloroethene, cis-1,2-	2.0E-05	0.035	NA	NC	NA	NA	1	2E-06	7E-05	NA	7E-05
Dichloroethene, 1,1-	1.1E-04	0.2	NA	1	NA	NA	1	1E-05	7E-05	NA	7E-05
Tetrachloroethene	4.2E-04	4.6	0.00001	1	7E-07	7E-09	1	5E-05	1E-05	7E-09	1E-05
Trans-1,2-Dichloroethene	2.9E-05	0.7	NA	NC	NA	NA	1	3E-06	5E-06	NA	5E-06
Trichloroethane, 1,1,1-	2.0E-04	5.2	NA	NC	NA	NA	1	2E-05	5E-06	NA	5E-06
Trichloroethene	7.6E-05	0.18	0.0000017	1	1E-07	2E-10	1	9E-06	5E-05	2E-10	5E-05
Vinyl chloride	8.6E-05	0.1	0.0000088	1	1E-07	1E-09	1	1E-05	1E-04	1E-09	1E-04
Total						9E-09			3E-04	9E-09	3E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-49
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
Unifirst
Current Resident at Alston St.
Soil

Receptor:	Resident
Medium:	Soil
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-ci	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPc	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times TWA}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{os} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CS$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	5.5E-02	0.0007	0.13	1	2E-08	3E-09	1	1E-07	2E-04	0.1	2E-08	3E-09	0.1	1E-07	2E-04	5E-09	4E-04
Chloroethane	1.4E-01	0.4	NA	NC	NA	NA	1	3E-07	8E-07	NC	NA	NA	0.1	3E-07	7E-07	NA	2E-06
Chloroform	5.5E-02	0.01	NA	NA	NA	NA	1	1E-07	1E-05	NC	NA	NA	0.1	1E-07	1E-05	NA	2E-05
Dichloroethane, 1,1-	5.5E-02	0.1	NA	NC	NA	NA	1.3	2E-07	2E-06	NC	NA	NA	0.13	1E-07	1E-06	NA	3E-05
Dichloroethane, cis-1,2-	5.5E-02	0.01	NA	NC	NA	NA	1	1E-07	1E-05	NC	NA	NA	0.1	1E-07	1E-05	NA	2E-05
Dichloroethane, 1,1-	5.5E-02	0.05	NA	NC	NA	NA	1	1E-07	3E-06	NC	NA	NA	0.1	1E-07	2E-06	NA	5E-06
Tetrachloroethene	5.5E-02	0.01	0.051	1	2E-08	1E-09	1	1E-07	1E-05	0.1	2E-08	1E-09	0.1	1E-07	1E-05	2E-09	2E-05
Trans-1,2-Dichloroethene	5.5E-02	0.02	NA	NC	NA	NA	1	1E-07	7E-06	NC	NA	NA	0.1	1E-07	6E-06	NA	1E-05
Trichloroethane, 1,1,1-	5.5E-02	0.09	NA	NC	NA	NA	1	1E-07	1E-06	NC	NA	NA	0.1	1E-07	1E-06	NA	3E-06
Trichloroethene	5.5E-02	0.002	0.011	1	2E-08	2E-10	1	1E-07	7E-05	0.1	2E-08	2E-10	0.1	1E-07	6E-05	5E-10	1E-04
Vinyl chloride	5.5E-02	0.003	1.4	1.53	3E-08	4E-08	1	1E-07	4E-05	0.16	3E-08	5E-08	0.1	1E-07	4E-05	9E-08	8E-05
Total						5E-08			4E-04						3E-04	1E-07	7E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-50
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Current Resident at Alston St
Ambient Air

Receptor:	▼
Medium of Origin:	▼
Exposure Medium:	▼
Exposure Area:	▼
Depth:	▼
Duration:	▼

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRair TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.6	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$
$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hflng	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	5.5E-02	1.8E-09	0.43	0.000015	0.0007	0.13	1	2E-11	9E-11	1E-12	1E-10	1E-11	1	6E-11	2E-10	5E-10	2E-10	3E-07	1E-11	3E-07
Chloroethane	1.4E-01	4.5E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	2E-10	5E-10	5E-11	5E-10	1E-09	NA	1E-09
Chloroform	5.5E-02	1.8E-09	0.66	0.000023	0.01	NA	1	2E-11	9E-11	2E-12	NA	NA	1	6E-11	2E-10	3E-10	2E-10	2E-08	2E-12	2E-08
Dichloroethane, 1,1-	5.5E-02	1.8E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	4E-10	2E-10	2E-09	NA	2E-09
Dichloroethane, cis-1,2-	5.5E-02	1.8E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	6E-09	2E-10	2E-08	NA	2E-08
Dichloroethane, 1,1-	5.5E-02	1.8E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	6E-11	2E-10	1E-09	2E-10	4E-09	NA	5E-09
Tetrachloroethene	1.8E-09	1.8E-09	4.6	0.00001	0.01	0.051	1	2E-11	9E-11	9E-13	1E-10	5E-12	1	6E-11	2E-10	5E-11	2E-10	2E-08	6E-12	2E-08
Trans-1,2-Dichloroethene	5.5E-02	1.8E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	3E-09	2E-10	9E-09	NA	1E-08
Trichloroethane, 1,1,1-	5.5E-02	1.8E-09	5.2	NA	0.09	NA	NC	NA	NA	1E-13	1E-10	1E-12	1	6E-11	2E-10	4E-11	2E-10	2E-09	NA	2E-09
Trichloroethene	5.5E-02	1.8E-09	0.18	0.0000017	0.002	0.011	1	2E-11	9E-11	8E-13	1E-10	1E-10	1	6E-11	2E-10	1E-09	2E-10	9E-08	1E-12	9E-08
Vinyl chloride	5.5E-02	1.8E-09	0.1	0.0000088	0.003	1.4	1	2E-11	9E-11	5E-12	1E-10	1E-10	1	6E-11	2E-10	2E-09	2E-10	6E-08	1E-10	6E-08
Total										5E-12		2E-10				1E-08		5E-07	2E-10	5E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-51
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Resident at Alston St.
Ambient Air

Receptor:	Resident
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Outdoor Air Data		RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Compound	Ambient Air (mg/m3)										
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane,1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	7.0E-04	4.6	0.00001	1	4E-05	4E-07	1	1E-04	2E-05	4E-07	2E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane,1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	8E-05	1E-05	NA	1E-05
Trichloroethene	5.5E-04	0.18	0.0000017	1	3E-05	5E-08	1	8E-05	4E-04	5E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						6E-07			4E-03	6E-07	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-52
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
Unifirst
Future Resident at Alston St.
Soil

Receptor:	Resident	▼
Medium:	Soil	▼
Exposure Area:	Future	▼
Depth:	0-15 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	100	
IR _{soil} TWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-c	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPC	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{soil} \times EF \times EP}{AP \times BW}$$
$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{os} \times EF}{AP}$$
$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$
$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$
$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing-c} \times CSF$$
$$Risk_{der} = ADD_{der-c} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling			
Carbon tetrachloride	4.5E-02	0.0007	0.13	1	2E-08	2E-09	1	1E-07	2E-04	9E-08	4E-09	3E-04
Chloroethane	1.1E-01	0.4	NA	NC	NA	NA	1	3E-07	7E-07	2E-07	NA	1E-06
Chloroform	4.5E-02	0.01	NA	NA	NA	NA	1	1E-07	1E-05	9E-08	NA	2E-05
Dichloroethane, 1,1-	4.5E-02	0.1	NA	NC	NA	NA	1.3	1E-07	1E-06	1E-07	NA	3E-06
Dichloroethene, cis-1,2-	4.5E-02	0.01	NA	NC	NA	NA	1	1E-07	1E-05	9E-08	NA	2E-05
Dichloroethene, 1,1-	4.5E-02	0.05	NA	NC	NA	NA	1	1E-07	2E-06	9E-08	NA	4E-06
Tetrachloroethene	4.5E-02	0.01	0.051	1	2E-08	9E-10	1	1E-07	1E-05	9E-08	2E-09	2E-05
Trans-1,2-Dichloroethene	4.5E-02	0.02	NA	NC	NA	NA	1	1E-07	5E-06	9E-08	NA	1E-05
Trichloroethane, 1,1,1-	4.5E-02	0.09	NA	NC	NA	NA	1	1E-07	1E-06	9E-08	NA	2E-06
Trichloroethene	4.5E-02	0.002	0.011	1	2E-08	2E-10	1	1E-07	5E-05	9E-08	4E-10	1E-04
Vinyl chloride	4.5E-02	0.003	1.4	1.53	3E-08	4E-08	1	1E-07	4E-05	9E-08	7E-08	7E-05
Total						4E-08			3E-04	2E-04	8E-08	5E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-53
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Future Resident at Alston St
Ambient Air

Receptor:	Resident
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0.6	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$

$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$

$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	R/C (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFiFc	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.5E-02	1.4E-09	0.43	0.000015	0.0007	0.13	1	2E-11	7E-11	1E-12	8E-11	1E-11	1	5E-11	2E-10	4E-10	2E-10	2E-07	1E-11	2E-07
Chloroethane	1.1E-01	3.5E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	4E-10	4E-11	4E-10	9E-10	NA	1E-09
Chloroform	4.5E-02	1.4E-09	0.66	0.000023	0.01	NA	1	2E-11	7E-11	2E-12	NA	NA	1	5E-11	2E-10	3E-10	2E-10	2E-08	2E-12	2E-08
Dichloroethane, 1,1-	4.5E-02	1.4E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	4E-10	2E-10	2E-09	NA	2E-09
Dichloroethane, cis-1,2-	4.5E-02	1.4E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	5E-09	2E-10	2E-08	NA	2E-08
Dichloroethane, 1,1,1-	4.5E-02	1.4E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	5E-11	2E-10	9E-10	2E-10	3E-09	NA	4E-09
Tetrachloroethene	4.5E-02	1.4E-09	4.6	0.00001	0.01	0.051	1	2E-11	7E-11	7E-13	8E-11	4E-12	1	5E-11	2E-10	4E-11	2E-10	2E-08	5E-12	2E-08
Trans-1,2-Dichloroethene	4.5E-02	1.4E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	3E-09	2E-10	8E-09	NA	1E-08
Trichloroethane, 1,1,1-	4.5E-02	1.4E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	1E-09	2E-10	8E-08	NA	2E-09
Trichloroethene	4.5E-02	1.4E-09	0.18	0.0000017	0.002	0.011	1	2E-11	7E-11	1E-13	8E-11	9E-13	1	5E-11	2E-10	1E-09	2E-10	1E-12	1E-10	8E-08
Vinyl chloride	4.5E-02	1.4E-09	0.1	0.0000088	0.003	1.4	1	2E-11	7E-11	6E-13	8E-11	1E-10	1	5E-11	2E-10	2E-09	2E-10	5E-08	1E-10	5E-08
Total										4E-12		1E-10				1E-08		4E-07		4E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-54
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at Alston St.
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air data Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane,1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene,1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	7.0E-04	4.6	0.00001	1	4E-05	4E-07	1	1E-04	2E-05	4E-07	2E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane,1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	8E-05	1E-05	NA	1E-05
Trichloroethene	5.5E-04	0.18	0.000017	1	3E-05	5E-08	1	8E-05	4E-04	5E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						6E-07			4E-03	6E-07	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-55
Exposure and Risk Estimates Associated With Soil Contact
50 Tutts Street, Somerville MA
UniFirst
Commercial Worker at Alston St.
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	50	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm ² -y/kg-d-c1	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPc	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Compound	Carbon tetrachloride	0.0007	0.13	1	5E-09	6E-10	1	1E-08	2E-05	0.1	1E-09	1E-10	0.1	3E-09	4E-06	7E-10	2E-05
	Chloroethane	0.4	NA	NC	NA	NA	1	3E-08	7E-08	NC	NA	NA	0.1	6E-09	2E-08	NA	9E-08
	Chloroform	0.01	NA	NA	NA	NA	1	1E-08	1E-06	NA	NA	NA	0.1	3E-09	3E-07	NA	1E-06
	Dichloroethane, 1,1-	0.1	NA	NC	NA	NA	1.3	2E-08	2E-07	NC	NA	NA	0.13	3E-09	3E-08	NA	2E-07
	Dichloroethane, cis-1,2-	0.01	NA	NC	NA	NA	1	1E-08	1E-06	NC	NA	NA	0.1	3E-09	3E-07	NA	1E-06
	Dichloroethene, 1,1-	0.05	NA	NC	NA	NA	1	1E-08	2E-07	NC	NA	NA	0.1	3E-09	5E-08	NA	3E-07
	Tetrachloroethene	0.01	0.051	1	5E-09	2E-10	1	1E-08	1E-06	0.1	1E-09	5E-11	0.1	3E-09	3E-07	3E-10	1E-06
	Trans-1,2-Dichloroethene	0.02	NA	NC	NA	NA	1	1E-08	6E-07	NC	NA	NA	0.1	3E-09	1E-07	NA	7E-07
	Trichloroethane, 1,1,1-	0.09	NA	NA	NC	NA	1	1E-08	1E-07	NC	NA	NA	0.1	3E-09	3E-08	NA	2E-07
	Trichloroethene	0.002	0.011	1	5E-09	5E-11	1	1E-08	6E-06	0.1	1E-09	1E-11	0.1	3E-09	1E-06	6E-11	7E-06
	Vinyl chloride	0.003	1.4	1.53	7E-09	1E-08	1	1E-08	4E-06	0.16	2E-09	2E-09	0.1	3E-09	8E-07	1E-08	5E-06
	Total						1E-08		3E-05			2E-09			7E-06	1E-08	4E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-56
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates In Air
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at Alston St.
Ambient Air

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	dy	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFine	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates In Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.5E-02	1.4E-09	0.43	0.000015	0.0007	0.13	1	1E-11	5E-11	8E-13	4E-11	6E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	6E-12	2E-07
Chloroethane	1.1E-01	3.5E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	9E-11	3E-10	3E-11	3E-10	7E-10	NA	7E-10
Chloroform	4.5E-02	1.4E-09	0.66	0.000023	0.01	NA	1	1E-11	5E-11	1E-12	NA	NA	1	4E-11	1E-10	2E-10	1E-10	1E-08	1E-12	1E-08
Dichloroethane, 1,1-	4.5E-02	1.4E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	3E-10	1E-10	1E-09	NA	1E-09
Dichloroethane, cis-1,2-	4.5E-02	1.4E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	4E-09	1E-10	1E-08	NA	1E-08
Dichloroethane, 1,1,1-	4.5E-02	1.4E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	4E-11	1E-10	7E-10	1E-10	2E-09	NA	3E-09
Tetrachloroethene	4.5E-02	1.4E-09	4.6	0.00001	0.01	0.051	1	1E-11	5E-11	5E-13	4E-11	2E-12	1	4E-11	1E-10	3E-11	1E-10	1E-08	3E-12	1E-08
Trans-1,2-Dichloroethene	4.5E-02	1.4E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	NA	7E-09
Trichloroethane, 1,1,1-	4.5E-02	1.4E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	3E-11	1E-10	1E-09	NA	1E-09
Trichloroethene	4.5E-02	1.4E-09	0.18	0.0000017	0.002	0.011	1	1E-11	5E-11	9E-14	4E-11	5E-13	1	4E-11	1E-10	7E-10	1E-10	6E-08	6E-13	6E-08
Vinyl chloride	4.5E-02	1.4E-09	0.1	0.0000088	0.003	1.4	1	1E-11	5E-11	4E-13	4E-11	6E-11	1	4E-11	1E-10	1E-09	1E-10	4E-08	6E-11	4E-08
Total										3E-12		7E-11				9E-09		3E-07	7E-11	3E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-57
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at Alston St.
Ambient Air

Receptor:	Commercial/Industrial Worker	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Current	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Data					Risk					HI (Ambient Air)
	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	(Ambient Air)	
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-05	9E-05	NA	9E-05
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-05	1E-03	NA	1E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-05	2E-04	NA	2E-04
Tetrachloroethene	7.0E-04	4.6	0.00001	1	3E-05	3E-07	1	8E-05	2E-05	3E-07	2E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-05	6E-04	NA	6E-04
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-05	1E-05	NA	1E-05
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-05	4E-08	1	6E-05	3E-04	4E-08	3E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	9E-08	1	3E-05	3E-04	9E-08	3E-04
Total						4E-07			3E-03	4E-07	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-58
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.
Soil - Dermal contact & Incidental Ingestion

Receptor:	Construction Worker
Medium:	Surface Soil
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.29	
EF	Soil Exposure Frequency	d/y	130	
EP	Soil Exposure Period - Cancer	y	1	
EP	Soil Exposure Period - Non-Cancer	y	1	
ATc	Soil Exposure Period - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	182	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{sa} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{da} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total Risk (Soil)	HI (Soil)
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling		
Carbon tetrachloride	4.5E-02	0.007	0.13	1	4E-10	5E-11	1	6E-08	8E-06	1E-10	2E-05
Chloroethane	1.1E-01	0.4	NA	NC	NA	NA	1	1E-07	3E-07	NA	7E-07
Chloroform	4.5E-02	0.01	NA	NA	NA	NA	1	6E-08	6E-06	NA	1E-05
Dichloroethane, 1,1-	4.5E-02	1	NA	NC	NA	NA	1.3	7E-08	7E-08	NA	1E-07
Dichloroethane, cis-1,2-	4.5E-02	0.1	NA	NC	NA	NA	1	6E-08	6E-07	NA	1E-06
Dichloroethane, 1,1-	4.5E-02	0.05	NA	NC	NA	NA	1	6E-08	1E-06	NA	2E-06
Tetrachloroethene	4.5E-02	0.1	0.051	1	4E-10	2E-11	1	6E-08	6E-07	4E-11	1E-06
Trans-1,2-Dichloroethene	4.5E-02	0.2	NA	NC	NA	NA	1	6E-08	3E-07	NA	6E-07
Trichloroethane, 1,1,1-	4.5E-02	0.9	NA	NC	NA	NA	1	6E-08	6E-08	NA	1E-07
Trichloroethene	4.5E-02	0.02	0.011	1	4E-10	4E-12	1	6E-08	3E-06	9E-12	6E-06
Vinyl chloride	4.5E-02	0.003	1.4	1.53	6E-10	8E-10	1	6E-08	2E-05	2E-09	4E-05
Total						9E-10			4E-05	2E-09	8E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-59
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St
Ambient Air

Receptor:	Construction Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	dy	130	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	182	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC	EPC	Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFin	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.5E-02	2.7E-09	0.43	0.000015	0.007	0.13	1	3E-12	1E-11	2E-13	1E-11	1E-12	1E-12	1	5E-10	2E-09	4E-09	1E-09	2E-07	2E-12	2E-07
Chloroethane	1.1E-01	6.6E-09	10	NA	0.4	NA	NC	3E-12	1E-11	NA	NA	NA	NA	1	1E-09	4E-09	4E-10	4E-09	9E-09	NA	9E-09
Chloroform	4.5E-02	2.7E-09	0.66	0.000023	0.01	NA	1	3E-12	1E-11	3E-13	NA	NA	NA	1	5E-10	2E-09	3E-09	1E-09	1E-07	3E-13	1E-07
Dichloroethane, 1,1-	4.5E-02	2.7E-09	5	NA	1	NA	NC	NA	NA	NA	NA	NA	NA	1	5E-10	2E-09	3E-10	1E-09	1E-09	NA	2E-09
Dichloroethane, cis-1,2-	4.5E-02	2.7E-09	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	NA	1	5E-10	2E-09	5E-08	1E-09	1E-08	NA	6E-08
Dichloroethane, 1,1-	4.5E-02	2.7E-09	0.2	NA	0.05	NA	1	3E-12	1E-11	1E-13	NA	NA	NA	1	5E-10	2E-09	8E-09	1E-09	3E-08	NA	4E-08
Tetrachloroethene	4.5E-02	2.7E-09	4.6	0.00001	0.1	0.051	NC	NA	NA	1E-13	1E-11	5E-13	5E-13	1	5E-10	2E-09	4E-10	1E-09	1E-08	6E-13	1E-08
Trans-1,2-Dichloroethene	4.5E-02	2.7E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	NA	1	5E-10	2E-09	2E-09	1E-09	7E-09	NA	1E-08
Trichloroethane, 1,1,1-	4.5E-02	2.7E-09	5.2	NA	0.9	NA	NC	NA	NA	2E-14	1E-11	1E-13	1E-13	1	5E-10	2E-09	9E-09	1E-09	7E-08	1E-13	8E-08
Trichloroethene	4.5E-02	2.7E-09	0.18	0.0000017	0.02	0.011	1	3E-12	1E-11	1E-13	1E-11	1E-11	1E-11	1	5E-10	2E-09	2E-08	1E-09	5E-07	1E-11	5E-07
Vinyl chloride	4.5E-02	2.7E-09	0.1	0.0000088	0.003	1.4	1	3E-12	1E-11	7E-13	2E-11	2E-11	2E-11	1	5E-10	2E-09	9E-08	1E-09	1E-06	2E-11	1E-06
Total																					

NA - Not available
NC - Not calculated
ND - Not detected

Table A-60
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H ¹ 's	Deff Vadose Zone (Layer A + Layer B)	Deff Total (Layer A + Layer B + Layer C)	Deffcrack (Layer A)	Exponent of Pecllet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.5E+02	1.53E-03	6.95E-03	9.35E-05	6.13E-06	3.91E-02	2.56E-03
Chloroethane	4.77E-01	5.35E-02	3.80E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.64E-02	3.25E-04	2.13E-05	1.10E-01	7.21E-03
Chloroform	8.04E-02	2.05E-02	1.46E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	5.06E-03	1.25E-04	8.17E-06	7.13E-03	4.67E-04
Dichloroethane, 1,1-	1.24E-01	1.46E-02	1.04E-02	1.46E-02	2.74E+109	5.3E+01	1.15E-03	5.25E-03	8.89E-05	5.83E-06	7.86E-03	5.15E-04
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	1.03E-02	1.45E-02	2.13E+110	3.6E+01	1.17E-03	5.34E-03	8.82E-05	5.78E-06	5.52E-03	3.62E-04
Dichloroethene, 1,1-	6.34E-01	1.78E-02	1.26E-02	1.78E-02	1.68E+90	6.5E+01	2.51E-03	1.14E-02	1.08E-04	7.07E-06	4.86E-02	3.18E-03
Tetrachloroethene	3.24E-01	1.42E-02	1.01E-02	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.83E-03	8.63E-05	5.65E-06	1.99E-02	1.30E-03
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	9.91E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	7.75E-03	8.48E-05	5.55E-06	1.28E-02	8.42E-04
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.4E+02	1.29E-03	5.85E-03	9.35E-05	6.13E-06	2.43E-02	1.59E-03
Trichloroethene	1.97E-01	1.56E-02	1.11E-02	1.56E-02	6.13E+102	9.4E+01	1.14E-03	5.18E-03	9.47E-05	6.20E-06	1.33E-02	8.70E-04
Vinyl chloride	7.65E-01	2.09E-02	1.49E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	2.14E-02	1.27E-04	8.32E-06	6.91E-02	4.52E-03

Table A-61
Site-specific Parameters for Volatilization Calculations
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.

Symbol	(units)	Parameter	Value	Comment
L_{CRACK}	(cm)	Thickness of foundation	15	
f_{OC}	(g/g)	Fraction organic carbon in vadose zone soil	0.02	
L_r	(15 or 200 cm)	Depth below grade to bottom of enclosed space floor	15	Input either 15 or 200
L_{WT}	(cm)	Depth below grade to water table	462	15.16 Ft.
T_g	Kelvin	Average soil/ groundwater temperature	283	10 (°C)
L_1	(cm)	Source- building separation	447	
L_g	(cm)	Length of building	961	DEP Default
W_g	(cm)	Width of building	951	DEP Default
H_g	(cm)	Floor- wall seam perimeter	488	DEP Default
X_{CRACK}	(cm)	Air exchange rate	3.84E+03	
ER	(1/hr)	Bldg. ventilation rate	0.45	DEP Default
$Q_{building}$	(cm ³ /s)	Area of enclosed space below grade	5.63E+04	
A_g	(cm ²)	Crack- to-total area ratio	9.24E+05	
η	(unitless)	Crack depth below grade	4.16E-04	
Z_{CRACK}	(cm)	Vapor viscosity at ave. soil temperature	15	
μ_{HS}	(g/cm-s)	Diffusion path length	1.75E-04	
L_d	(cm)	Convection path length	447	
L_p	(cm)	Crack radius	15	
r_{CRACK}	(cm)	Pressure differential between soil surface and enclosed space	0.10	DEP Default
ΔP	g/cm-s ²	Average vapor flow rate into bldg.	40	DEP Default
Q_{SOIL}	(cm ³ /s)	Area of crack	9.45E+01	
A_{CRACK}	(cm ²)	Gas constant	384	
Rc	(cal/mol-K)	Universal gas constant	1.99	
R	(atm-m ³ /mol-K)	Universal gas constant	8.21E-05	
R2	(mmHg-cm ³ /mol-K)	Universal gas constant	6.24E+04	
W_{SA}	(cm)	Width of soil source to ambient air	1.52E+03	50 Ft.
t_{SA}	(s)	Averaging time for volatilization from soil to ambient air	1.58E+07	0.5 y
U	(cm/s)	Wind speed	225	
D	(cm)	Mixing height	183	6 Ft.
Z_s	(cm)	Depth to soil source	462	15.16 Ft.
Z_{SO}	(cm)	Depth to soil gas source	462	15.16 Ft.
W_E	(cm)	Width of excavation	1524	50 Ft.
L_E	(cm)	Length of excavation	762	25 Ft.
H_E	(cm)	Height of excavation	457	15 Ft.
W_{EC}	(cm)	Width of excavation that is contaminated	1524	50 Ft.
L_{EC}	(cm)	Length of excavation that is contaminated	762	25 Ft.
H_{EC}	(cm)	Height of excavation that is contaminated	457	15 Ft.
WT	(cm)	Width of trench	457	15 Ft.
LT	(cm)	Length of trench	122	4 Ft.
HT	(cm)	Height of trench	183	6 Ft.
WTC	(cm)	Width of trench that is contaminated	457	15 Ft.
LTC	(cm)	Length of trench that is contaminated	122	4 Ft.
HTC	(cm)	Height of trench that is contaminated	183	6 Ft.
t_{SE}	(s)	Averaging time for volatilization from soil to excavation	1.58E+07	0.5 y
t_{ST}	(s)	Averaging time for volatilization from soil to trench	3.15E+07	1 y
F_E	(unitless)	Fraction of wind speed that occurs in excavation	0.5	
F_T	(unitless)	Fraction of wind speed that occurs in trench	0.1	
d	(cm)	Lower depth of surface soil source	462	15.16 Ft.
Vadose Zone				
Layer A				
P_b	(g/cm ³)	Vadose zone soil dry bulk density	1.5	1.5
n	(unitless)	Vadose zone soil total porosity	0.43	0.43
θ_w	(cm ³ /cm ³)	Vadose zone soil water-filled porosity	0.06	0.06
θ_a	(cm ³ /cm ³)	Vadose zone soil air-filled porosity	0.37	0.37
h	(cm)	Thickness of soil layer	15	415
S_{so}	(cm ³ /cm ³)	Vadose zone effective total fluid saturation	1.86E-02	17
k_i	(cm ²)	Vadose zone soil intrinsic permeability	9.92E-08	
k_{ag}	(cm ²)	Vadose zone soil relative air permeability	0.99	
k_v	(cm ²)	Vadose zone soil effective vapor permeability	9.79E-08	
Vadose Zone				
Layer B				
Capillary Zone				
Layer C				

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building Sand

Capillary zone Sand

Key:

Type in Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Values Assume all sources are 1 inch below excavation depth

Table A-62
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.
Excavation Air
Volatilization from Soil Gas

Receptor:	Construction Worker	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha pha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC		Alpha Volatilization from Soil Gas to Excavation Air (mg/m3 excav) / (mg/m3 SG)	Source Dilution Factor	EPC		RIC (mg/m3)	URF 1/(ug/m3)	mg/m3				Risk (Trench Air)		HI (Trench Air)	
	Soil Gas mg/m3				Excavation Air (mg/m3)				RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh		
Compound	mg/m3		(mg/m3 excav) / (mg/m3 SG)		(mg/m3)		(mg/m3)	1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	8E-12 NA NA NA NA NA 3E-11 NA NA NA 8E-13 1E-12	8E-08 6E-09 NA 2E-09 3E-07 7E-08 5E-08 1E-08 4E-09 2E-07 1E-07
Carbon tetrachloride	3.2E-03		9.35E-05	1	3.0E-07	0.43	0.000015	1	1	5E-10	8E-12	1	4E-08	8E-08	8E-08	
Chloroethane	1.4E-03		3.25E-04	1	4.7E-07	10	NA	NA	NC	NA	NA	1	6E-08	6E-09	6E-09	
Chloroform	NA		1.25E-04	1	NA	0.66	0.000023	0.000023	1	NA	NA	1	NA	NA	NA	
Dichloroethane, 1,1-	1.0E-03		8.89E-05	1	9.0E-08	5	NA	NA	NC	NA	NA	1	1E-08	2E-09	2E-09	
Dichloroethene, cis-1,2-	9.0E-04		8.82E-05	1	8.0E-08	0.035	NA	NA	NC	NA	NA	1	9E-09	3E-07	3E-07	
Dichloroethene, 1,1-	1.0E-03		1.08E-04	1	1.1E-07	0.2	NA	NA	1	NA	NA	1	1E-08	7E-08	7E-08	
Tetrachloroethene	2.2E-02		8.63E-05	1	1.9E-06	4.6	0.00001	0.00001	1	3E-09	3E-11	1	2E-07	5E-08	5E-08	
Trans-1,2-Dichloroethene	9.0E-04		8.48E-05	1	7.7E-08	0.7	NA	NA	NC	NA	NA	1	9E-09	1E-08	1E-08	
Trichloroethane, 1,1,1-	1.7E-03		9.35E-05	1	1.6E-07	5.2	NA	NA	NC	NA	NA	1	2E-08	4E-09	4E-09	
Trichloroethene	2.9E-03		9.47E-05	1	2.8E-07	0.18	0.000017	0.000017	1	5E-10	8E-13	1	3E-08	2E-07	2E-07	
Vinyl chloride	6.6E-04		1.27E-04	1	8.3E-08	0.1	0.0000088	0.0000088	1	1E-10	1E-12	1	1E-08	1E-07	1E-07	
Total											4E-11			8E-07	8E-07	

Table A-63
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.
Excavation Air
Volatilization from Subsurface Soil

Receptor:	Construction Worker
Medium of Origin:	Subsurface Soil
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Subsurface Soil mg/kg	VF Volatilization from Subsurface Soil to Excavation Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	4.5E-02	1.53E-03	1	6.9E-05	0.43	0.000015	1	1E-07	2E-09	1	8E-06	2E-05	2E-09	2E-05
Chloroethane	1.1E-01	5.80E-03	1	6.4E-04	10	NA	NC	NA	NA	1	8E-05	8E-06	NA	8E-06
Chloroform	4.5E-02	1.11E-03	1	5.0E-05	0.66	0.000023	1	8E-08	2E-09	1	6E-06	9E-06	2E-09	9E-06
Dichloroethane, 1,1-	4.5E-02	1.15E-03	1	5.2E-05	5	NA	NC	NA	NA	1	6E-06	1E-06	NA	1E-06
Dichloroethene, cis-1,2-	4.5E-02	1.17E-03	1	5.3E-05	0.035	NA	NC	NA	NA	1	6E-06	2E-04	NA	2E-04
Dichloroethene, 1,1-	4.5E-02	2.51E-03	1	1.1E-04	0.2	NA	1	NA	NA	1	1E-05	7E-05	NA	7E-05
Tetrachloroethene	4.5E-02	8.42E-04	1	3.8E-05	4.6	0.00001	1	6E-08	6E-10	1	4E-06	1E-06	6E-10	1E-06
Trans-1,2-Dichloroethene	4.5E-02	1.71E-03	1	7.7E-05	0.7	NA	NC	NA	NA	1	9E-06	1E-05	NA	1E-05
Trichloroethane, 1,1,1-	4.5E-02	1.29E-03	1	5.8E-05	5.2	NA	NC	NA	NA	1	7E-06	1E-06	NA	1E-06
Trichloroethene	4.5E-02	1.14E-03	1	5.1E-05	0.18	0.0000017	1	9E-08	1E-10	1	6E-06	3E-05	1E-10	3E-05
Vinyl chloride	4.5E-02	4.71E-03	1	2.1E-04	0.1	0.0000088	1	4E-07	3E-09	1	3E-05	3E-04	3E-09	3E-04
Total									8E-09			6E-04	8E-09	6E-04

Table A-64
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.
Excavation Air
Volatilization from Groundwater

Receptor:	Construction Worker
Medium of Origin:	Groundwater
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC (mg/L)	VF Volatilization from Excavation Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFc mg/m3	ADE-c mg/m3	Risk _{inh}	RAFinc	ADE-nc mg/m3	H _{inh}	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	5.0E-04	3.91E-02	1	2.0E-05	0.43	0.000015	1	3E-08	5E-10	1	2E-06	5E-06	5E-10	5E-06
Chloroethane	1.0E-03	1.10E-01	1	1.1E-04	10	NA	NC	NA	NA	1	1E-05	1E-06	NA	1E-06
Chloroform	5.0E-04	7.13E-03	1	3.6E-06	0.66	0.000023	1	6E-09	1E-10	1	4E-07	6E-07	1E-10	6E-07
Dichloroethane, 1,1-	5.0E-04	7.86E-03	1	3.9E-06	5	NA	NC	NA	NA	1	5E-07	9E-08	NA	9E-08
Dichloroethane, cis-1,2-	5.0E-04	5.52E-03	1	2.8E-06	0.035	NA	NC	NA	NA	1	3E-07	9E-06	NA	9E-06
Dichloroethane, 1,1-	5.0E-04	4.86E-02	1	2.4E-05	0.2	NA	1	NA	NA	1	3E-06	1E-05	NA	1E-05
Tetrachloroethene	5.3E-04	1.99E-02	1	1.1E-05	4.6	0.00001	1	2E-08	2E-10	1	1E-06	3E-07	2E-10	3E-07
Trans-1,2-Dichloroethene	5.0E-04	1.28E-02	1	6.4E-06	0.7	NA	NC	NA	NA	1	8E-07	1E-06	NA	1E-06
Trichloroethane, 1,1,1-	5.0E-04	2.43E-02	1	1.2E-05	5.2	NA	NC	NA	NA	1	1E-06	3E-07	NA	3E-07
Trichloroethene	2.0E-03	1.33E-02	1	2.6E-05	0.18	0.0000017	1	4E-08	7E-11	1	3E-06	2E-05	7E-11	2E-05
Vinyl chloride	5.0E-04	6.91E-02	1	3.5E-05	0.1	0.0000088	1	6E-08	5E-10	1	4E-06	4E-05	5E-10	4E-05
Total									1E-09			9E-05	1E-09	9E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-65
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at Alston St.
Excavation Air

Receptor:	Construction Worker	▼
Medium of Origin:		▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

All 3 media

$$C_{air} = \frac{C_{SOURCE} \times (VF \text{ or } \alpha) \times SDF}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	3.0E-05	0.43	0.000015	1	5E-08	8E-10	1	4E-06	8E-06	8E-10	8E-06
Chloroethane	2.5E-04	10	NA	NC	NA	NA	1	3E-05	3E-06	NA	3E-06
Chloroform	2.7E-05	0.66	0.000023	1	5E-08	1E-09	1	3E-06	5E-06	1E-09	5E-06
Dichloroethane, 1,1-	1.9E-05	5	NA	NC	NA	NA	1	2E-06	4E-07	NA	4E-07
Dichloroethene, cis-1,2-	1.9E-05	0.035	NA	NC	NA	NA	1	2E-06	6E-05	NA	6E-05
Dichloroethene, 1,1-	4.6E-05	0.2	NA	1	NA	NA	1	5E-06	3E-05	NA	3E-05
Tetrachloroethene	1.7E-05	4.6	0.00001	1	3E-08	3E-10	1	2E-06	4E-07	3E-10	4E-07
Trans-1,2-Dichloroethene	2.8E-05	0.7	NA	NC	NA	NA	1	3E-06	5E-06	NA	5E-06
Trichloroethane, 1,1,1-	2.3E-05	5.2	NA	NC	NA	NA	1	3E-06	5E-07	NA	5E-07
Trichloroethene	2.6E-05	0.18	0.000017	1	4E-08	7E-11	1	3E-06	2E-05	7E-11	2E-05
Vinyl chloride	8.2E-05	0.1	0.000088	1	1E-07	1E-09	1	1E-05	1E-04	1E-09	1E-04
Total						3E-09			2E-04	3E-09	2E-04

NA - Not available
NC - Not calculated
ND - Not detected
Assumes groundwater is directly beneath the excavation

Table A-66
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Current Resident along Tufts St.
Soil

Receptor:	Resident	▼
Medium:	Soil	▼
Exposure Area:	Current	▼
Depth:	0-3 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-c1	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPC	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATC	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} TWA \times RAF_{os} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CSF$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	R/D (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total				
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosc	ADDder-c mg/kg-d	Riskder	RAFDsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	8.0E-02	0.0007	0.13	1	3E-08	4E-09	1	2E-07	3E-08	0.1	2E-07	2E-04	8E-09	5E-04
Chloroethane	2.0E-01	0.4	NA	NC	NA	NA	1	5E-07	1E-06	NC	4E-07	1E-06	NA	2E-06
Chloroform	NA	0.01	NA	NC	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	8.5E-02	0.1	NA	NC	NA	NA	1.3	3E-07	3E-06	NC	2E-07	2E-06	NA	5E-06
Dichloroethane, cis-1,2-	8.5E-02	0.01	NA	NC	NA	NA	1	2E-07	2E-05	NC	2E-07	2E-05	NA	4E-05
Dichloroethene, 1,1-	8.5E-02	0.05	NA	NC	NA	NA	1	2E-07	4E-06	NC	2E-07	3E-06	NA	8E-06
Tetrachloroethene	9.9E-02	0.01	0.051	1	4E-08	2E-09	1	2E-07	2E-05	0.1	2E-07	2E-05	4E-09	4E-05
Trans-1,2-Dichloroethene	8.0E-02	0.02	0.02	NC	NA	NA	1	2E-07	1E-05	NC	2E-07	8E-06	NA	2E-05
Trichloroethane, 1,1,1-	8.5E-02	0.09	NA	NC	NA	NA	1	2E-07	2E-06	NC	2E-07	2E-06	NA	4E-06
Trichloroethene	8.0E-02	0.002	0.011	1	3E-08	3E-10	1	2E-07	1E-04	0.1	2E-07	8E-05	7E-10	2E-04
Vinyl chloride	8.0E-02	0.003	1.4	1.53	5E-08	6E-08	1	2E-07	6E-05	0.16	2E-07	5E-05	1E-07	1E-04
Total						7E-08			5E-04			4E-04	1E-07	9E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-67
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Current Resident along Tufts St
Ambient Air

Receptor:

Resident

Medium of Origin:

Soil

Exposure Medium:

Ambient Air

Exposure Area:

Current

Depth:

0-3 feet

Duration:

Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	1	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$
$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$
$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFinC	ADD-inhrc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	8.0E-02	2.6E-09	0.43	0.000015	0.0007	0.13	1	4E-11	1E-10	2E-12	1E-10	2E-11	1	9E-11	3E-10	7E-10	3E-10	4E-07	2E-11	4E-07
Chloroethane	2.0E-01	6.4E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	2E-10	8E-10	8E-11	7E-10	2E-09	NA	2E-09
Chloroform	NA	NA	0.66	0.000023	0.01	NA	1	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	8.5E-02	2.7E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	9E-11	3E-10	7E-10	3E-10	3E-09	NA	4E-09
Dichloroethane, cis-1,2-	8.5E-02	2.7E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	9E-11	3E-10	9E-09	3E-10	3E-08	NA	4E-08
Dichloroethene, 1,1-	9.9E-02	2.7E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	9E-11	3E-10	2E-09	3E-10	6E-09	NA	7E-09
Tetrachloroethene	3.2E-09	3.2E-09	4.6	0.00001	0.01	0.051	1	4E-11	2E-10	2E-12	2E-10	9E-12	1	1E-10	4E-10	8E-11	3E-10	3E-08	1E-11	3E-08
Trans-1,2-Dichloroethene	8.0E-02	2.6E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	9E-11	3E-10	4E-09	3E-10	1E-08	NA	2E-08
Trichloroethane, 1,1,1-	8.5E-02	2.7E-09	5.2	NA	0.09	NA	NC	NA	NA	2E-13	1E-10	2E-12	1	9E-11	3E-10	6E-11	3E-10	3E-09	NA	3E-09
Trichloroethene	8.0E-02	2.6E-09	0.18	0.0000017	0.002	0.011	1	4E-11	1E-10	1E-12	1E-10	2E-10	1	9E-11	3E-10	2E-09	3E-10	1E-07	2E-12	1E-07
Vinyl chloride	8.0E-02	2.6E-09	0.1	0.0000088	0.003	1.4	1	4E-11	1E-10	1E-12	1E-10	2E-10	1	9E-11	3E-10	3E-09	3E-10	9E-08	2E-10	9E-08
Total										5E-12		2E-10				2E-08		7E-07		2E-10

NA - Not available
NC - Not calculated
ND - Not detected

Table A-68
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Resident along Tufts St.
Ambient Air

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Receptor:	Resident	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Current	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	3.5E-03	4.6	0.00001	1	2E-04	2E-06	1	5E-04	1E-04	2E-06	1E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane, 1,1,1-	7.4E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.3E-04	0.18	0.0000017	1	4E-05	6E-08	1	9E-05	5E-04	6E-08	5E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						2E-06			4E-03	2E-06	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-69
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Future Resident along Tufts St.
Soil

Receptor:	Resident
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPC	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{os} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CS$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFosc	ADDing-c mg/kg-d	Risking	RAFoscnc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFdsnc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	2.8E-02	0.0007	0.13	1	1E-08	1E-09	1	7E-08	1E-04	0.1	1E-08	1E-09	0.1	6E-08	8E-05	3E-09	2E-04
Chloroethane	5.6E-02	0.4	NA	NC	NA	NA	1	1E-07	3E-07	NC	NA	NA	0.1	1E-07	3E-07	NA	6E-07
Chloroform	2.8E-02	0.01	NA	NC	NA	NA	1	7E-08	7E-06	NC	NA	NA	0.1	6E-08	6E-06	NA	1E-05
Dichloroethane, 1,1-	2.8E-02	0.1	NA	NC	NA	NA	1.3	9E-08	9E-07	NC	NA	NA	0.13	7E-08	7E-07	NA	2E-06
Dichloroethene, cis-1,2-	2.8E-02	0.01	NA	NC	NA	NA	1	7E-08	7E-06	NC	NA	NA	0.1	6E-08	6E-06	NA	1E-05
Dichloroethene, 1,1-	2.8E-02	0.05	NA	NC	NA	NA	1	7E-08	1E-06	NC	NA	NA	0.1	6E-08	1E-06	NA	2E-06
Tetrachloroethene	3.2E-01	0.01	0.051	1	1E-07	6E-09	1	8E-07	8E-05	0.1	1E-07	6E-09	0.1	7E-07	7E-05	1E-08	1E-04
Trans-1,2-Dichloroethene	2.8E-02	0.02	NA	NC	NA	NA	1	7E-08	3E-06	NC	NA	NA	0.1	6E-08	3E-06	NA	6E-06
Trichloroethane, 1,1,1-	8.0E-02	0.09	NA	NC	NA	NA	1	2E-07	2E-06	NC	NA	NA	0.1	2E-07	2E-06	NA	4E-06
Trichloroethene	2.8E-02	0.002	0.011	1	1E-08	1E-10	1	7E-08	3E-05	0.1	1E-08	1E-10	0.1	6E-08	3E-05	2E-10	6E-05
Vinyl chloride	2.8E-02	0.003	1.4	1.53	2E-08	2E-08	1	7E-08	2E-05	0.16	2E-08	2E-08	0.1	6E-08	2E-05	5E-08	4E-05
Total						3E-08			3E-04			3E-08			2E-04	6E-08	5E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-70
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirel
Future Resident along Tufts St.
Ambient Air

Receptor:

Resident

Medium of Origin:

Soil

Exposure Medium:

Ambient Air

Exposure Area:

Future

Depth:

0-15 feet

Duration:

Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRak TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	1	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	dy	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$
$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhc mg/kg-d	ADE-nc mg/m3	HIinh	ADD-ingnc	HIing	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	2.8E-02	8.9E-10	0.43	0.000015	0.0007	0.13	1	1E-11	4E-11	7E-13	5E-11	6E-12	1	3E-11	1E-10	3E-10	9E-11	1E-07	7E-12	1E-07
Chloroethane	5.6E-02	1.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	2E-11	2E-10	5E-10	NA	5E-10
Chloroform	2.8E-02	8.9E-10	0.66	0.000023	0.01	NA	1	1E-11	4E-11	1E-12	NA	NA	1	3E-11	1E-10	2E-10	9E-11	9E-09	1E-12	9E-09
Dichloroethane, 1,1-	2.8E-02	8.9E-10	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	3E-11	1E-10	2E-10	9E-11	9E-10	NA	1E-09
Dichloroethane, cis-1,2-	2.8E-02	8.9E-10	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	3E-11	1E-10	3E-09	9E-11	9E-09	NA	1E-08
Dichloroethane, 1,1-	2.8E-02	8.9E-10	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	3E-11	1E-10	5E-10	9E-11	2E-09	NA	2E-09
Tetrachloroethene	3.2E-01	1.0E-08	4.6	0.00001	0.01	0.051	1	1E-10	5E-10	5E-12	6E-10	3E-11	1	4E-10	1E-09	3E-10	1E-09	1E-07	3E-11	1E-07
Trans-1,2-Dichloroethene	2.8E-02	8.9E-10	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	3E-11	1E-10	2E-09	9E-11	5E-09	NA	6E-09
Trichloroethane, 1,1,1-	8.0E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	7E-14	NA	NA	1	9E-11	3E-10	6E-11	3E-10	3E-09	NA	3E-09
Trichloroethene	2.8E-02	8.9E-10	0.18	0.000017	0.002	0.011	1	1E-11	4E-11	4E-13	5E-11	5E-13	1	3E-11	1E-10	6E-10	9E-11	5E-08	6E-13	5E-08
Vinyl chloride	2.8E-02	8.9E-10	0.1	0.0000088	0.003	1.4	1	1E-11	4E-11	7E-12	5E-11	7E-11	1	3E-11	1E-10	1E-09	9E-11	3E-08	7E-11	3E-08
Total																8E-09		3E-07		4E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-71
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident along Tufts St.
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Data Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	5E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	3.5E-03	4.6	0.00001	1	2E-04	2E-06	1	5E-04	1E-04	2E-06	1E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	5E-05	8E-04	NA	8E-04
Trichloroethane, 1,1,1-	7.4E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.3E-04	0.18	0.0000017	1	4E-05	6E-08	1	9E-05	5E-04	6E-08	5E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						2E-06			4E-03	2E-06	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-72
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
Unifirst
Future Commercial Worker along Tufts St.
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	50	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsnc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	2.8E-02	0.0007	0.13	1	3E-09	4E-10	1	7E-09	1E-05	0.1	6E-10	8E-11	0.1	2E-09	2E-06	5E-10	1E-05
Chloroethane	5.6E-02	0.4	NA	NC	NA	NA	1	1E-08	4E-08	NC	NA	NA	0.1	3E-09	8E-09	NA	5E-08
Chloroform	2.8E-02	0.01	NA	NA	NA	NA	1	7E-09	7E-07	NA	NA	NA	0.1	2E-09	2E-07	NA	9E-07
Dichloroethane, 1,1-	2.8E-02	0.1	NA	NC	NA	NA	1.3	1E-08	1E-07	NC	NA	NA	0.13	2E-09	2E-08	NA	1E-07
Dichloroethene, cis-1,2-	2.8E-02	0.01	NA	NC	NA	NA	1	7E-09	7E-07	NC	NA	NA	0.1	2E-09	2E-07	NA	9E-07
Dichloroethene, 1,1-	2.8E-02	0.05	NA	NC	NA	NA	1	7E-09	1E-07	NC	NA	NA	0.1	2E-09	3E-08	NA	2E-07
Tetrachloroethene	3.2E-01	0.01	0.051	1	3E-08	2E-09	1	9E-08	9E-06	0.1	7E-09	4E-10	0.1	2E-08	2E-06	2E-09	1E-05
Trans-1,2-Dichloroethene	2.8E-02	0.02	NA	NC	NA	NA	1	7E-09	4E-07	NC	NA	NA	0.1	2E-09	8E-08	NA	5E-07
Trichloroethane, 1,1,1-	8.0E-02	0.09	NA	NC	NA	NA	1	2E-08	2E-07	NC	NA	NA	0.1	4E-09	5E-08	NA	3E-07
Trichloroethene	2.8E-02	0.002	0.011	1	3E-09	3E-11	1	7E-09	4E-06	0.1	6E-10	7E-12	0.1	2E-09	8E-07	4E-11	5E-06
Vinyl chloride	2.8E-02	0.003	1.4	1.53	4E-09	6E-09	1	7E-09	2E-06	0.16	1E-09	1E-09	0.1	2E-09	5E-07	8E-09	3E-06
Total						8E-09			3E-05			2E-09			6E-06	1E-08	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-73
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tuttle Street, Somerville MA
UnFirst
Future Commercial Worker along Tuttle St
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRair TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIg	ADD-inh-c mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhnc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	2.8E-02	8.9E-10	0.43	0.000015	0.0007	0.13	1	9E-12	3E-11	5E-13	3E-11	3E-12	1	2E-11	8E-11	2E-10	7E-11	1E-07	4E-12	1E-07
Chloroethane	5.6E-02	1.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	2E-11	1E-10	3E-10	NA	4E-10
Chloroform	2.8E-02	8.9E-10	0.66	0.000023	0.01	NA	1	9E-12	3E-11	7E-13	NA	NA	1	2E-11	8E-11	1E-10	7E-11	7E-09	7E-13	7E-09
Dichloroethane, 1,1-	2.8E-02	8.9E-10	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	2E-11	8E-11	2E-10	7E-11	7E-10	NA	9E-10
Dichloroethane, cis-1,2-	2.8E-02	8.9E-10	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	2E-11	8E-11	2E-09	7E-11	7E-09	NA	9E-09
Dichloroethane, 1,1-	2.8E-02	8.9E-10	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	3E-10	9E-10	4E-10	7E-11	1E-09	NA	2E-09
Tetrachloroethene	3.2E-01	1.0E-08	4.6	0.00001	0.01	0.051	1	1E-10	4E-10	4E-12	3E-10	2E-11	1	3E-10	9E-10	2E-10	8E-10	8E-08	2E-11	8E-08
Trans-1,2-Dichloroethene	2.8E-02	8.9E-10	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	2E-11	8E-11	1E-09	7E-11	3E-09	NA	5E-09
Trichloroethane, 1,1,1-	8.0E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	7E-11	2E-10	4E-11	2E-10	2E-09	NA	2E-09
Trichloroethene	2.8E-02	8.9E-10	0.18	0.0000017	0.002	0.011	1	9E-12	3E-11	5E-14	3E-11	3E-13	1	2E-11	8E-11	4E-10	7E-11	3E-08	3E-13	3E-08
Vinyl chloride	2.8E-02	8.9E-10	0.1	0.0000088	0.003	1.4	1	9E-12	3E-11	3E-13	3E-11	4E-11	1	2E-11	8E-11	8E-10	7E-11	2E-08	4E-11	2E-08
Total										5E-12		6E-11				6E-09		3E-07	6E-11	3E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-74
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Commercial Worker along Tufts St.
Ambient Air

Receptor:	Commercial/Industrial Worker	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air data	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinh	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane,1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-05	9E-05	NA	9E-05
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-05	1E-03	NA	1E-03
Dichloroethene,1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-05	2E-04	NA	2E-04
Tetrachloroethene	3.5E-03	4.6	0.00001	1	1E-04	1E-06	1	4E-04	8E-05	1E-06	8E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-05	6E-04	NA	6E-04
Trichloroethane,1,1,1-	7.4E-04	5.2	NA	NC	NA	NA	1	8E-05	2E-05	NA	2E-05
Trichloroethene	6.3E-04	0.18	0.0000017	1	3E-05	5E-08	1	7E-05	4E-04	5E-08	4E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-05	9E-08	1	3E-05	3E-04	9E-08	3E-04
Total						2E-06			3E-03	2E-06	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-75
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
Unifirst
Construction Worker along Tufts St.
Soil - Dermal contact & Incidental Ingestion

Receptor:	Construction Worker
Medium:	Surface Soil
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.29	
EF	Soil Exposure Frequency	d/y	130	
EP	Soil Exposure Period - Cancer	y	1	
EP	Soil Exposure Period - Non-Cancer	y	1	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	182	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Hlder	Total Risk (Soil)	HI (Soil)					
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling				RAFDsc	ADDder-c mg/kg-d	Riskder	RAFDsnc	ADDder-nc mg/kg-d
Carbon tetrachloride	2.8E-02	0.007	0.13	1	2E-10	3E-11	1	3E-08	5E-06	0.1	2E-10	3E-11	0.1	3E-08	5E-06	6E-11	1E-05
Chloroethane	5.6E-02	0.4	NA	NC	NA	NA	1	7E-08	2E-07	NC	NA	NA	0.1	7E-08	2E-07	NA	3E-07
Chloroform	2.8E-02	0.01	NA	NA	NA	NA	1	3E-08	3E-06	NA	NA	NA	0.1	3E-08	3E-06	NA	7E-06
Dichloroethane, 1,1-	2.8E-02	1	NA	NC	NA	NA	1.3	4E-08	4E-08	NC	NA	NA	0.13	4E-08	4E-08	NA	9E-08
Dichloroethene, cis-1,2-	2.8E-02	0.1	NA	NC	NA	NA	1	3E-08	3E-07	NC	NA	NA	0.1	3E-08	3E-07	NA	7E-07
Dichloroethene, 1,1-	2.8E-02	0.05	NA	NC	NA	NA	1	3E-08	7E-07	NC	NA	NA	0.1	3E-08	7E-07	NA	1E-06
Tetrachloroethene	3.2E-01	0.1	0.051	1	3E-09	1E-10	1	4E-07	4E-06	0.1	3E-09	1E-10	0.1	4E-07	4E-06	3E-10	8E-06
Trans-1,2-Dichloroethene	2.8E-02	0.2	NA	NC	NA	NA	1	3E-08	2E-07	NC	NA	NA	0.1	3E-08	2E-07	NA	3E-07
Trichloroethane, 1,1,1-	8.0E-02	0.9	NA	NC	NA	NA	1	1E-07	1E-07	NC	NA	NA	0.1	1E-07	1E-07	NA	2E-07
Trichloroethene	2.8E-02	0.02	0.011	1	2E-10	3E-12	1	3E-08	2E-06	0.1	2E-10	3E-12	0.1	3E-08	2E-06	5E-12	3E-06
Vinyl chloride	2.8E-02	0.003	1.4	1.53	4E-10	5E-10	1	3E-08	1E-05	0.16	4E-10	6E-10	0.1	3E-08	1E-05	1E-09	2E-05
Total						7E-10			3E-05			7E-10			3E-05	1E-09	5E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-76
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Construction Worker along Tufts St.
Ambient Air

Receptor:	Construction Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-hg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	130	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	182	
BW	Body Weight	kg	58	
G	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC	EPC	Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	2.8E-02		1.7E-09	0.43	0.000015	0.007	0.13	1	2E-12	7E-12	1E-13	6E-12	8E-13	1	3E-10	1E-09	2E-09	9E-10	1E-07	9E-13	1E-07
Chloroethane	5.6E-02		3.3E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	6E-10	2E-09	2E-10	2E-09	4E-09	NA	5E-09
Chloroform	2.8E-02		1.7E-09	0.66	0.000023	0.01	NA	1	2E-12	7E-12	2E-13	NA	NA	1	3E-10	1E-09	2E-09	9E-10	9E-08	2E-13	9E-08
Dichloroethane, 1,1-	2.8E-02		1.7E-09	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	3E-10	1E-09	2E-10	9E-10	1E-09	NA	1E-09
Dichloroethane, cis-1,2-	2.8E-02		1.7E-09	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	3E-10	1E-09	3E-08	9E-10	9E-09	NA	4E-08
Dichloroethene, 1,1-	2.8E-02		1.7E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	3E-10	1E-09	5E-09	9E-10	2E-08	NA	2E-08
Tetrachloroethene	3.2E-01		1.9E-08	4.6	0.00001	0.1	0.051	1	2E-11	9E-11	9E-13	7E-11	4E-12	1	3E-09	1E-08	3E-09	1E-08	1E-07	5E-12	1E-07
Trans-1,2-Dichloroethene	2.8E-02		1.7E-09	0.7	0.00001	0.2	NA	NC	NA	NA	NA	NA	NA	1	3E-10	1E-09	1E-09	9E-10	4E-09	NA	6E-09
Trichloroethane, 1,1,1-	8.0E-02		4.8E-09	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	NA	1	8E-10	3E-09	6E-10	3E-09	3E-09	NA	3E-09
Trichloroethene	2.8E-02		1.7E-09	0.18	0.0000017	0.02	0.011	1	2E-12	7E-12	1E-14	6E-12	7E-14	1	3E-10	1E-09	6E-09	9E-10	4E-08	8E-14	5E-08
Vinyl chloride	2.8E-02		1.7E-09	0.1	0.0000088	0.003	1.4	1	2E-12	7E-12	6E-14	6E-12	9E-12	1	3E-10	1E-09	1E-08	9E-10	3E-07	9E-12	3E-07
Total											1E-12		1E-11				6E-08		7E-07	1E-11	8E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-77
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Construction Worker along Tufts St.

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H'_{TS}	Deff Vadose Zone (Layer A + Layer B)	Deff Total (Layer A + Layer B + Layer C)	Deffcrack (Layer A)	Exponent of Pecllet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.5E+02	1.53E-03	6.95E-03	9.35E-05	6.13E-06	3.91E-02	2.56E-03
Chloroethane	4.77E-01	5.35E-02	3.80E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.64E-02	3.25E-04	2.13E-05	1.10E-01	7.21E-03
Chloroform	8.04E-02	2.05E-02	1.46E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	5.06E-03	1.25E-04	8.17E-06	7.13E-03	4.67E-04
Dichloroethane, 1,1-	1.24E-01	1.46E-02	1.04E-02	1.46E-02	2.74E+109	5.3E+01	1.15E-03	5.25E-03	8.89E-05	5.83E-06	7.86E-03	5.15E-04
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	1.03E-02	1.45E-02	2.13E+110	3.6E+01	1.17E-03	5.34E-03	8.82E-05	5.78E-06	5.52E-03	3.62E-04
Dichloroethene, 1,1-	6.34E-01	1.78E-02	1.26E-02	1.78E-02	1.68E+90	6.5E+01	2.51E-03	1.14E-02	1.08E-04	7.07E-06	4.86E-02	3.18E-03
Tetrachloroethene	3.24E-01	1.42E-02	1.01E-02	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.83E-03	8.63E-05	5.65E-06	1.99E-02	1.30E-03
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	9.91E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	7.75E-03	8.48E-05	5.55E-06	1.28E-02	8.42E-04
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.4E+02	1.29E-03	5.85E-03	9.35E-05	6.13E-06	2.43E-02	1.59E-03
Trichloroethene	1.97E-01	1.56E-02	1.11E-02	1.56E-02	6.13E+102	9.4E+01	1.14E-03	5.18E-03	9.47E-05	6.20E-06	1.33E-02	8.70E-04
Vinyl chloride	7.65E-01	2.09E-02	1.49E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	2.14E-02	1.27E-04	8.32E-06	6.91E-02	4.52E-03

Table A-78
Site-specific Parameters for Volatilization Calculations
50 Tufts Street, Somerville MA
UniFirst
Construction Worker along Tufts St

Symbol	(units)	Parameter	Value	Comment																																	
L _{crack}	(cm)	Thickness of foundation	15																																		
f _{oc}	(g/g)	Fraction organic carbon in vadose zone soil	0.02																																		
L _f	(15 or 200 cm)	Depth below grade to bottom of enclosed space floor	15	Input either 15 or 200																																	
L _{wtr}	(cm)	Depth below grade to water table	462	15.16 Ft.																																	
T _g	Kelvin	Average soil/ groundwater temperature	283	10 (°C)																																	
L _b	(cm)	Source- building separation	447																																		
L _i	(cm)	Length of building	961	DEP Default																																	
W _s	(cm)	Width of building	961	DEP Default																																	
H _g	(cm)	Floor- wall seam perimeter	488	DEP Default																																	
X _{crack}	(cm)	Floor- wall seam perimeter	3.84E+03																																		
ER	(1/hr)	Air exchange rate	0.45	DEP Default																																	
Q _{building}	(cm ² /s)	Bldg. ventilation rate	5.63E+04																																		
A _g	(cm ²)	Area of enclosed space below grade	9.24E+05																																		
η	(unitless)	Crack- to-total area ratio	4.16E-04																																		
Z _{crack}	(cm)	Crack depth below grade	15																																		
μ _{ts}	(g/cm-s)	Vapor viscosity at ave. soil temperature	1.75E-04																																		
L _d	(cm)	Diffusion path length	447																																		
L _p	(cm)	Convection path length	15																																		
r _{crack}	(cm)	Crack radius	0.10	DEP Default																																	
ΔP	g/cm-s ²	Pressure differential between soil surface and enclosed space	40	DEP Default																																	
Q _{soil}	(cm ² /s)	Average vapor flow rate into bldg.	9.45E+01																																		
A _{crack}	(cm ²)	Area of crack	384																																		
R _c	(cal/mol-K)	Gas constant	1.99E+00																																		
R	(atm-m ³ /mol-K)	Universal gas constant	8.21E-05																																		
R ₂	(mmHg-cm ³ /mol-K)	Universal gas constant	6.24E+04																																		
W _{sa}	(cm)	Width of soil source to ambient air	1.52E+03	50 Ft.																																	
t _{ga}	(s)	Averaging time for volatilization from soil to ambient air	1.58E+07	0.5 y																																	
U	(cm/s)	Wind speed	225																																		
D	(cm)	Mixing height	183	6 Ft.																																	
Z _s	(cm)	Depth to soil source	462	15.16 Ft.																																	
Z _{sg}	(cm)	Depth to soil gas source	462	15.16 Ft.																																	
W _e	(cm)	Width of excavation	1524	50 Ft.																																	
L _e	(cm)	Length of excavation	762	25 Ft.																																	
H _e	(cm)	Height of excavation	457	15 Ft.																																	
W _{ec}	(cm)	Width of excavation that is contaminated	1524	50 Ft.																																	
L _{ec}	(cm)	Length of excavation that is contaminated	762	25 Ft.																																	
H _{ec}	(cm)	Height of excavation that is contaminated	457	15 Ft.																																	
WT	(cm)	Width of trench	457	15 Ft.																																	
LT	(cm)	Length of trench	122	4 Ft.																																	
HT	(cm)	Height of trench	183	6 Ft.																																	
WTC	(cm)	Width of trench that is contaminated	457	15 Ft.																																	
LTC	(cm)	Length of trench that is contaminated	122	4 Ft.																																	
HTC	(cm)	Height of trench that is contaminated	183	6 Ft.																																	
t _{se}	(s)	Averaging time for volatilization from soil to excavation	1.58E+07	0.5 y																																	
t _{st}	(s)	Averaging time for volatilization from soil to trench	3.15E+07	1 y																																	
F _e	(unitless)	Fraction of wind speed that occurs in excavation	0.5																																		
F _t	(unitless)	Fraction of wind speed that occurs in trench	0.1																																		
d	(cm)	Lower depth of surface soil source	462	15.16 Ft.																																	
<table><tr><th>Vadose Zone</th><th>Vadose Zone</th><th>Capillary Zone</th></tr><tr><td>Layer A</td><td>Layer B</td><td></td></tr><tr><td>1.5</td><td>1.5</td><td>1.5</td></tr><tr><td>0.43</td><td>0.43</td><td>0.43</td></tr><tr><td>0.06</td><td>0.06</td><td>0.25</td></tr><tr><td>0.37</td><td>0.37</td><td>0.18</td></tr><tr><td>15</td><td>415</td><td>17</td></tr><tr><td></td><td></td><td>1.86E-02</td></tr><tr><td></td><td></td><td>9.92E-08</td></tr><tr><td></td><td></td><td>0.99</td></tr><tr><td></td><td></td><td>9.79E-08</td></tr></table>					Vadose Zone	Vadose Zone	Capillary Zone	Layer A	Layer B		1.5	1.5	1.5	0.43	0.43	0.43	0.06	0.06	0.25	0.37	0.37	0.18	15	415	17			1.86E-02			9.92E-08			0.99			9.79E-08
Vadose Zone	Vadose Zone	Capillary Zone																																			
Layer A	Layer B																																				
1.5	1.5	1.5																																			
0.43	0.43	0.43																																			
0.06	0.06	0.25																																			
0.37	0.37	0.18																																			
15	415	17																																			
		1.86E-02																																			
		9.92E-08																																			
		0.99																																			
		9.79E-08																																			
P _b	(g/cm ³)	Vadose zone soil dry bulk density																																			
n	(unitless)	Vadose zone soil total porosity																																			
a _w	(cm ³ /cm ³)	Vadose zone soil water-filled porosity																																			
θ _a	(cm ³ /cm ³)	Vadose zone soil air-filled porosity																																			
h	(cm)	Thickness of soil layer																																			
S _{se}	(cm ³ /cm ³)	Vadose zone effective total fluid saturation																																			
k _i	(cm ²)	Vadose zone soil intrinsic permeability																																			
k _{og}	(cm ²)	Vadose zone soil relative air permeability																																			
k _v	(cm ²)	Vadose zone soil effective vapor permeability																																			

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building

Sand

Capillary zone

Sand

Key:

Type in Site-specific values here

Calculated values

Constants

Default parameter values from DEP

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building Sand

Capillary zone Sand

Key:

Type in Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Values Assume all sources are 1 inch below excavation depth

Table A-79

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker along Tufts St.
Excavation Air
Volatilization from Soil Gas

Receptor:	Construction Worker	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

	EPC	Alpha Volatilization from Soil Gas to Excavation Air (mg/m3 excav) / (mg/m3 SG)	Source Dilution Factor	EPC	RIC	URF	RAFiC	ADE-c	Riskinh	RAFiC	ADE-nc	Hlinh	Risk (Trench Air)	HI (Trench Air)
Compound	Soil Gas			Excavation Air	(mg/m3)	1/(ug/m3)		mg/m3			mg/m3			
Carbon tetrachloride Chloroethane Chloroform Dichloroethane, 1,1- Dichloroethene, cis-1,2- Dichloroethene, 1,1- Tetrachloroethene Trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride	1.3E-02	9.35E-05	1	1.2E-06	0.43	0.000015	1	2E-09	3E-11	1	1E-07	3E-07	3E-11	3E-07
	5.5E-03	3.25E-04	1	1.8E-06	10	NA	NC	NA	NA	1	2E-07	2E-08	NA	2E-08
	NA	1.25E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
	8.0E-03	8.89E-05	1	7.1E-07	5	NA	NC	NA	NA	1	8E-08	2E-08	NA	2E-08
	8.0E-03	8.82E-05	1	7.1E-07	0.035	NA	NC	NA	NA	1	8E-08	2E-06	NA	2E-06
	8.0E-03	1.08E-04	1	8.6E-07	0.2	NA	1	NA	NA	1	1E-07	5E-07	NA	5E-07
	8.8E+00	8.63E-05	1	7.6E-04	4.6	0.00001	1	1E-06	1E-08	1	9E-05	2E-05	1E-08	2E-05
	8.0E-03	8.48E-05	1	6.8E-07	0.7	NA	NC	NA	NA	1	8E-08	1E-07	NA	1E-07
	3.3E-01	9.35E-05	1	3.1E-05	5.2	NA	NC	NA	NA	1	4E-06	7E-07	NA	7E-07
	3.2E-02	9.47E-05	1	3.0E-06	0.18	0.0000017	1	5E-09	9E-12	1	4E-07	2E-06	9E-12	2E-06
5.0E-03	1.27E-04	1	6.4E-07	0.1	0.0000088	1	1E-09	9E-12	1	8E-08	8E-07	9E-12	8E-07	
Total									1E-08			3E-05	1E-08	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-80
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker along Tufts St.
Excavation Air
Volatilization from Subsurface Soil

Receptor:	Construction Worker
Medium of Origin:	Subsurface Soil
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

	EPC	VF Volatilization from Subsurface Soil to Excavation Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Compound	Subsurface Soil mg/kg			Excavation Air (mg/m3)										
Carbon tetrachloride	2.8E-02	1.53E-03	1	4.3E-05	0.43	0.000015	1	7E-08	1E-09	1	5E-06	1E-05	1E-09	1E-05
Chloroethane	5.6E-02	5.80E-03	1	3.2E-04	10	NA	NC	NA	NA	1	4E-05	4E-06	NA	4E-06
Chloroform	2.8E-02	1.11E-03	1	3.1E-05	0.66	0.000023	1	5E-08	1E-09	1	4E-06	6E-06	1E-09	6E-06
Dichloroethane, 1,1-	2.8E-02	1.15E-03	1	3.2E-05	5	NA	NC	NA	NA	1	4E-06	8E-07	NA	8E-07
Dichloroethene, cis-1,2-	2.8E-02	1.17E-03	1	3.3E-05	0.035	NA	NC	NA	NA	1	4E-06	1E-04	NA	1E-04
Dichloroethene, 1,1-	2.8E-02	2.51E-03	1	7.0E-05	0.2	NA	1	NA	NA	1	8E-06	4E-05	NA	4E-05
Tetrachloroethene	3.2E-01	8.42E-04	1	2.7E-04	4.6	0.00001	1	5E-07	5E-09	1	3E-05	7E-06	5E-09	7E-06
Trans-1,2-Dichloroethene	2.8E-02	1.71E-03	1	4.7E-05	0.7	NA	NC	NA	NA	1	6E-06	8E-06	NA	8E-06
Trichloroethane, 1,1,1-	8.0E-02	1.29E-03	1	1.0E-04	5.2	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Trichloroethene	2.8E-02	1.14E-03	1	3.2E-05	0.18	0.000017	1	5E-08	9E-11	1	4E-06	2E-05	9E-11	2E-05
Vinyl chloride	2.8E-02	4.71E-03	1	1.3E-04	0.1	0.0000088	1	2E-07	2E-09	1	2E-05	2E-04	2E-09	2E-04
Total									9E-09			4E-04	9E-09	4E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-81

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA

UniFirst

Construction Worker along Tufts St.

Excavation Air

Volatilization from Groundwater

Receptor:	Construction Worker	▼
Medium of Origin:	Groundwater	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC (mg/L)	VF Volatilization from Excavation Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RAFc	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	5.0E-04	3.91E-02	1	2.0E-05	0.43	0.000015	1	3E-08	5E-10	1	2E-06	5E-06	5E-10	5E-06
Chloroethane	1.0E-03	1.10E-01	1	1.1E-04	10	NA	NC	NA	NA	1	1E-05	1E-06	NA	1E-06
Chloroform	5.0E-04	7.13E-03	1	3.6E-06	0.66	0.000023	1	6E-09	1E-10	1	4E-07	6E-07	1E-10	6E-07
Dichloroethane, 1,1-	1.3E-02	7.86E-03	1	1.0E-04	5	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Dichloroethane, cis-1,2-	1.3E-02	5.52E-03	1	7.0E-05	0.035	NA	NC	NA	NA	1	8E-06	2E-04	NA	2E-04
Dichloroethane, 1,1-	1.3E-02	4.86E-02	1	6.2E-04	0.2	NA	1	NA	NA	1	7E-05	4E-04	NA	4E-04
Tetrachloroethene	1.2E+01	1.99E-02	1	2.5E-01	4.6	0.00001	1	4E-04	4E-06	1	3E-02	6E-03	4E-06	6E-03
Trans-1,2-Dichloroethene	5.0E-04	1.28E-02	1	6.4E-06	0.7	NA	NC	NA	NA	1	8E-07	1E-06	NA	1E-06
Trichloroethane, 1,1,1-	9.2E-02	2.43E-02	1	2.2E-03	5.2	NA	NC	NA	NA	1	3E-04	5E-05	NA	5E-05
Trichloroethene	1.0E-01	1.33E-02	1	1.4E-03	0.18	0.000017	1	2E-06	4E-09	1	2E-04	9E-04	4E-09	9E-04
Vinyl chloride	5.0E-04	6.91E-02	1	3.5E-05	0.1	0.0000088	1	6E-08	5E-10	1	4E-06	4E-05	5E-10	4E-05
Total									4E-06			8E-03	4E-06	8E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-82
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker along Tufts St.
Excavation Air

Receptor:	Construction Worker	▼
Medium of Origin:		▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

All 3 media

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)	
	Average of 3 media (mg/m3)											
Carbon tetrachloride Chloroethane Chloroform Dichloroethane, 1,1- Dichloroethene, cis-1,2- Dichloroethene, 1,1- Tetrachloroethene Trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride	2.1E-05	0.43	0.000015	1	4E-08	5E-10	1	3E-06	6E-06	5E-10	6E-06	
	1.4E-04	10	NA	NC	NA	NA	1	2E-05	2E-06	NA	2E-06	
	1.7E-05	0.66	0.000023	1	3E-08	7E-10	1	2E-06	3E-06	7E-10	3E-06	
	4.4E-05	5	NA	NC	NA	NA	1	5E-06	1E-06	NA	1E-06	
	3.5E-05	0.035	NA	NC	NA	NA	1	4E-06	1E-04	NA	1E-04	
	2.3E-04	0.2	NA	1	NA	NA	1	3E-05	1E-04	NA	1E-04	
	8.3E-02	4.6	0.00001	1	1E-04	1E-06	1	1E-02	2E-03	1E-06	2E-03	
	1.8E-05	0.7	NA	NC	NA	NA	1	2E-06	3E-06	NA	3E-06	
	7.9E-04	5.2	NA	NC	NA	NA	1	9E-05	2E-05	NA	2E-05	
	4.6E-04	0.18	0.0000017	1	8E-07	1E-09	1	5E-05	3E-04	1E-09	3E-04	
	5.5E-05	0.1	0.0000088	1	9E-08	8E-10	1	7E-06	7E-05	8E-10	7E-05	
	Total						1E-06			3E-03	1E-06	3E-03

NA - Not available
NC - Not calculated
ND - Not detected
Assumes groundwater is directly beneath the excavation

Table A-83
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Current Resident at other streets
Soil

Receptor:	Resident
Medium:	Soil
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPc	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{soil} \times EF \times EP}{AP \times BW}$$

$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times TWA \times RAF_{nc} \times EF}{AP}$$

$$ADD_{der-c} = \frac{C_{soil} \times CF \times SATWA \times RAF_{ds} \times EF}{AP}$$

$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$

$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing-c} \times CSF$$

$$Risk_{der} = ADD_{der-c} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFosc	ADDing-c mg/kg-d	Risking	RAFsosc	ADDing-nc mg/kg-d	Hling	Dermal Contact RAFdsc	ADDder-c mg/kg-d	Riskder	RAFsdsnc	ADDder-nc mg/kg-d	Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	4.9E-02	0.0007	0.13	1	2E-08	2E-09	1	1E-07	2E-04	0.1	2E-08	2E-09	0.1	1E-07	1E-04	5E-09	3E-04
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-07	7E-07	NC	NA	NA	0.1	2E-07	6E-07	NA	1E-06
Chloroform	4.9E-02	0.01	NA	NC	NA	NA	1	1E-07	1E-05	NC	NA	NA	0.1	1E-07	1E-05	NA	2E-05
Dichloroethane, 1,1-	1.3E-01	0.1	NA	NC	NA	NA	1.3	4E-07	4E-06	NC	NA	NA	0.13	3E-07	3E-06	NA	8E-06
Dichloroethene, cis-1,2-	4.9E-02	0.01	NA	NC	NA	NA	1	1E-07	1E-05	NC	NA	NA	0.1	1E-07	1E-05	NA	2E-05
Dichloroethene, 1,1-	4.9E-02	0.05	NA	NC	NA	NA	1	1E-07	2E-06	NC	NA	NA	0.1	1E-07	2E-06	NA	4E-06
Tetrachloroethene	9.9E-01	0.01	0.051	1	4E-07	2E-08	1	2E-06	2E-04	0.1	4E-07	2E-08	0.1	2E-06	2E-04	4E-08	4E-04
Trans-1,2-Dichloroethene	4.9E-02	0.02	NA	NC	NA	NA	1	1E-07	6E-06	NC	NA	NA	0.1	1E-07	5E-06	NA	1E-05
Trichloroethane, 1,1,1-	7.7E-02	0.09	NA	NC	NA	NA	1	2E-07	2E-06	NC	NA	NA	0.1	2E-07	2E-06	NA	4E-06
Trichloroethene	3.6E-01	0.002	0.011	1	1E-07	1E-09	1	9E-07	4E-04	0.1	1E-07	2E-09	0.1	7E-07	4E-04	3E-09	8E-04
Vinyl chloride	4.9E-02	0.003	1.4	1.53	3E-08	4E-08	1	1E-07	4E-05	0.16	3E-08	4E-08	0.1	1E-07	3E-05	8E-08	7E-05
Total						6E-08			9E-04			7E-08			8E-04	1E-07	2E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-84
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tuttle Street, Somerville MA
Unifirst
Current Resident at other streets
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Soil	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Current	▼
Depth:	0-3 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-hg	0.6	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$
$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFIc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhnc mg/kg-d	ADE-nc mg/m3	HIinh	ADD-ingnc	HIing	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.9E-02	1.6E-09	0.43	0.000015	0.0007	0.13	1	2E-11	8E-11	1E-12	9E-11	1E-11	1	5E-11	2E-10	4E-10	2E-10	2E-07	1E-11	2E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	5E-11	4E-10	1E-09	NA	1E-09
Chloroform	4.9E-02	1.6E-09	0.66	0.000023	0.01	NA	1	2E-11	8E-11	2E-12	NA	NA	1	5E-11	2E-10	3E-10	2E-10	2E-08	2E-12	2E-08
Dichloroethane, 1,1-	1.3E-01	4.2E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	1E-09	4E-10	4E-09	NA	5E-09
Dichloroethane, cis-1,2-	4.9E-02	1.6E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	5E-09	2E-10	2E-08	NA	2E-08
Dichloroethane, 1,1-	4.9E-02	1.6E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	5E-11	2E-10	9E-10	2E-10	3E-09	NA	4E-09
Tetrachloroethene	9.9E-01	3.2E-08	4.6	0.00001	0.01	0.051	1	4E-10	2E-09	2E-11	2E-09	9E-11	1	1E-09	4E-09	3E-10	3E-09	8E-07	1E-10	3E-07
Trans-1,2-Dichloroethene	4.9E-02	1.6E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	5E-11	2E-10	3E-09	2E-10	8E-09	NA	1E-08
Trichloroethene	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	1E-12	6E-10	7E-12	1	9E-11	3E-10	6E-11	3E-10	3E-09	NA	3E-09
Trichloroethene, 1,1,1-	3.6E-01	1.1E-08	0.18	0.0000017	0.002	0.011	1	2E-10	6E-10	7E-13	9E-11	1E-10	1	4E-10	1E-09	8E-09	1E-09	6E-07	8E-12	6E-07
Vinyl chloride	4.9E-02	1.6E-09	0.1	0.0000088	0.003	1.4	1	2E-11	8E-11	2E-11	9E-11	2E-10	1	5E-11	2E-10	2E-09	2E-10	5E-08	1E-10	6E-08
Total										2E-11						2E-08		1E-06	3E-10	1E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-85
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Resident at other streets
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Current	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Data	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.7E-04	0.5	NA	NC	NA	NA	1	6E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	6E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.6E-04	0.2	NA	1	NA	NA	1	6E-05	3E-04	NA	3E-04
Tetrachloroethene	8.2E-04	4.6	0.00001	1	5E-05	5E-07	1	1E-04	2E-05	5E-07	2E-05
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	6E-05	9E-04	NA	9E-04
Trichloroethane, 1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	9E-05	2E-05	NA	2E-05
Trichloroethene	6.4E-04	0.18	0.000017	1	4E-05	6E-08	1	9E-05	5E-04	6E-08	5E-04
Vinyl chloride	3.0E-04	0.1	0.0000088	1	2E-05	2E-07	1	4E-05	4E-04	2E-07	4E-04
Total						7E-07			4E-03	7E-07	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-86
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at other streets
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	50	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-ci	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.03	
EF	Soil Exposure Frequency	d/y	120	
EPC	Soil Exposure Period - Cancer	y	27	
EPnc	Soil Exposure Period - Non-Cancer	y	27	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total Risk (Soil) YC-OC-A	HI (Soil) YC
				RAFIsc	ADDIng-c mg/kg-d	RiskIng	RAFIscnc	ADDder-nc mg/kg-d	Hlder		
Carbon tetrachloride	4.9E-02	0.0007	0.13	1	5E-09	7E-10	1	1E-08	1E-08	8E-10	2E-05
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	3E-08	2E-08	NA	1E-07
Chloroform	4.9E-02	0.01	NA	NA	NA	NA	1	1E-08	3E-07	NA	2E-06
Dichloroethane, 1,1-	1.3E-01	0.1	NA	NC	NA	NA	1.3	5E-08	9E-08	NA	5E-07
Dichloroethane, cis-1,2-	4.9E-02	0.01	NA	NC	NA	NA	1	1E-08	3E-07	NA	2E-06
Dichloroethene, 1,1-	4.9E-02	0.05	NA	NC	NA	NA	1	1E-08	5E-08	NA	3E-07
Tetrachloroethene	9.9E-01	0.01	0.051	1	1E-07	5E-09	1	3E-07	6E-06	6E-09	3E-05
Trans-1,2-Dichloroethene	4.9E-02	0.02	NA	NC	NA	NA	1	1E-08	1E-07	NA	8E-07
Trichloroethane, 1,1,1-	7.7E-02	0.09	NA	NC	NA	NA	1	2E-08	5E-08	NA	3E-07
Trichloroethene	3.6E-01	0.002	0.011	1	4E-08	4E-10	1	1E-07	1E-05	5E-10	6E-05
Vinyl chloride	4.9E-02	0.003	1.4	1.53	8E-09	1E-08	1	1E-08	9E-07	1E-08	5E-06
Total						2E-08			2E-05	2E-08	1E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-87
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Commercial Worker at other streets
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	0-3 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$

$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-Ihnc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFINE	ADD-Ihnc mg/kg-d	ADE-nc mg/m3	HlInh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.9E-02	1.6E-09	0.43	0.000015	0.0007	0.13	1	2E-11	5E-11	8E-13	5E-11	6E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	7E-12	2E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	1E-10	3E-10	3E-11	3E-10	7E-10	NA	8E-10
Chloroform	4.9E-02	1.6E-09	0.66	0.000023	0.01	NA	1	2E-11	5E-11	1E-12	NA	NA	1	4E-11	1E-10	2E-10	1E-10	1E-08	1E-12	1E-08
Dichloroethane, 1,1-	1.3E-01	4.2E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	1E-10	4E-10	8E-10	3E-10	3E-09	NA	4E-09
Dichloroethane, cis-1,2-	4.9E-02	1.6E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	4E-09	1E-10	1E-08	NA	2E-08
Dichloroethane, 1,1-	4.9E-02	1.6E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	4E-11	1E-10	7E-10	1E-10	2E-09	NA	3E-09
Tetrachloroethene	9.9E-01	3.2E-08	4.6	0.00001	0.01	0.051	NC	3E-10	1E-09	1E-11	9E-10	5E-11	1	8E-11	3E-09	6E-10	2E-09	6E-11	6E-11	2E-07
Trans-1,2-Dichloroethene	4.9E-02	1.6E-09	0.07	NA	0.02	NA	1	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	NA	8E-09
Trichloroethane, 1,1,1-	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	4E-11	2E-10	2E-09	NA	2E-09
Trichloroethene	3.6E-01	1.1E-08	0.18	0.0000017	0.002	0.011	1	1E-10	4E-10	7E-13	3E-10	4E-12	1	3E-10	1E-09	6E-09	9E-10	4E-07	4E-12	4E-07
Vinyl chloride	4.9E-02	1.6E-09	0.1	0.0000088	0.003	1.4	1	2E-11	5E-11	5E-13	5E-11	6E-11	1	4E-11	1E-10	1E-09	1E-10	4E-08	7E-11	4E-08
Total										1E-11		1E-10				2E-08		9E-07	1E-10	1E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-88
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at other streets
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Current
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

OUTDOOR AIR DATA		RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Compound	Ambient Air (mg/m3)										
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane,1,1-	4.7E-04	0.5	NA	NC	NA	NA	1	5E-05	1E-04	NA	1E-04
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	5E-05	1E-03	NA	1E-03
Dichloroethene, 1,1-	4.6E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04
Tetrachloroethene	8.2E-04	4.6	0.00001	1	3E-05	3E-07	1	9E-05	2E-05	3E-07	2E-05
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	5E-05	7E-04	NA	7E-04
Trichloroethane, 1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	7E-05	1E-05	NA	1E-05
Trichloroethene	6.4E-04	0.18	0.0000017	1	3E-05	5E-08	1	7E-05	4E-04	5E-08	4E-04
Vinyl chloride	3.0E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04
Total						5E-07			3E-03	5E-07	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-89

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA

UniFirst

Current Commercial Worker at other streets

Indoor Air

163 Glen Street

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	163 Glen Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	9E-05	5E-04	NA	5E-04
Tetrachloroethene	1.7E-03	4.6	0.00001	1	1E-04	1E-06	1	4E-04	8E-05	1E-06	8E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	7.6E-04	5.2	NA	NC	NA	NA	1	2E-04	3E-05	NA	3E-05
Trichloroethene	5.5E-04	0.18	1.7E-06	1	5E-05	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	2E-05	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total						2E-06			6E-03	2E-06	6E-03

NA - Not available

NC - Not calculated

ND - Not detected

Table A-90
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at other streets
Indoor Air
85 Washington Street

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	85 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	NC	NA	NA	1	9E-05	5E-04	NA	5E-04
Tetrachloroethene	1.0E-03	4.6	0.00001	1	9E-05	9E-07	1	2E-04	5E-05	9E-07	5E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	5.5E-04	0.18	0.000017	1	5E-05	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	2E-05	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total						1E-06			6E-03	1E-06	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-91
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at other streets
Indoor Air
91-95 Washington Street

Receptor:	Commercial/Industrial Worker	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	91-95 Washington Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC				URF 1/(ug/m3)	Risk				HI (Indoor Air)
	Indoor Air (mg/m3)	RfC (mg/m3)	RAFc	ADE-c mg/m3	Riskinh	RAFinh	ADE-nc mg/m3	Hlinh		
Carbon tetrachloride	NA	0.43	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	1	0.000023	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	1	NA	NA	1	9E-05	5E-04	NA	5E-04
Tetrachloroethene	4.0E-03	4.6	1	0.00001	4E-06	1	9E-04	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	5.5E-04	0.18	1	0.0000017	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	1	0.0000088	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total					4E-06			6E-03	4E-06	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-92

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
 50 Tufts Street, Somerville MA
 UniFirst
 Current Commercial Worker at other streets
 Indoor Air
 97 Washington Street

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	97 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	9E-05	5E-04	NA	5E-04
Tetrachloroethene	1.4E-03	4.6	0.00001	1	1E-04	1E-06	1	3E-04	7E-05	1E-06	7E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	7.1E-04	5.2	NA	NC	NA	NA	1	2E-04	3E-05	NA	3E-05
Trichloroethene	5.5E-04	0.18	0.0000017	1	5E-05	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	2E-05	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total						2E-06			6E-03	2E-06	6E-03

NA - Not available
 NC - Not calculated
 ND - Not detected

Table A-93
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Commercial Worker at other streets
Indoor Air
121 Washington Street

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	121 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	8	
EF	Indoor Air Exposure Frequency	d/y	250	
EP	Indoor Air Exposure Period - Cancer	y	27	
EP	Indoor Air Exposure Period - Non-Cancer	y	27	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	9855	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethane, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethane, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	9E-04	5E-04	NA	5E-04
Tetrachloroethene	1.3E-03	4.6	0.00001	1	1E-04	1E-06	1	3E-04	6E-05	1E-06	6E-05
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	8.2E-04	5.2	NA	NC	NA	NA	1	2E-04	4E-05	NA	4E-05
Trichloroethene	5.5E-04	0.18	0.0000017	1	5E-05	8E-08	1	1E-04	7E-04	8E-08	7E-04
Vinyl chloride	2.6E-04	0.1	0.0000088	1	2E-05	2E-07	1	6E-05	6E-04	2E-07	6E-04
Total						1E-06			6E-03	1E-06	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-94
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Current Student risks at Capuano School
Soil

Receptor:	Student (4 yr old)
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{oc} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2495	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/yr	208	
EPC	Soil Exposure Period - Cancer	yr	2	
EPnc	Soil Exposure Period - Non-Cancer	yr	2	
ATc	Soil Exposure Period - Cancer	d	25550	
ATn	Soil Exposure Period - Non-Cancer	d	730	
BW	Body Weight	kg	16	
CF	Conversion Factor	kg/mg	0.000001	

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Hlder	Total Risk (Soil) YC-OC-A	HI (Soil) YC
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling			
Carbon tetrachloride	4.9E-02	0.0007	0.13	1	5E-09	6E-10	1	2E-07	2E-04	2E-04	1E-09	5E-04
Chloroethane	1.2E-01	0.4	NA	NC	NA	NA	1	4E-07	1E-06	9E-07	NA	2E-06
Chloroform	4.9E-02	0.01	NA	NA	NA	NA	1	2E-07	2E-05	1E-05	NA	3E-05
Dichloroethane, 1,1-	1.3E-01	0.1	NA	NC	NA	NA	1.3	6E-07	6E-06	5E-07	NA	1E-05
Dichloroethane, cis-1,2-	4.9E-02	0.01	NA	NC	NA	NA	1	2E-07	2E-05	1E-07	NA	3E-05
Dichloroethane, 1,1-	4.9E-02	0.05	NA	NC	NA	NA	1	2E-07	3E-06	3E-06	NA	6E-06
Tetrachloroethene	9.9E-01	0.01	0.051	1	1E-07	5E-09	1	3E-06	3E-04	1E-07	9E-09	6E-04
Trans-1,2-Dichloroethene	4.9E-02	0.02	NA	NC	NA	NA	1	2E-07	8E-06	7E-06	NA	2E-05
Trichloroethane, 1,1,1-	7.7E-02	0.09	NA	NC	NA	NA	1	3E-07	3E-06	3E-06	NA	6E-06
Trichloroethene	3.6E-01	0.002	0.011	1	4E-08	4E-10	1	1E-06	6E-04	5E-04	7E-10	1E-03
Vinyl chloride	4.9E-02	0.003	1.4	1.53	7E-09	1E-08	1	2E-07	6E-05	5E-05	2E-08	1E-04
Total						2E-08			1E-03	1E-03	3E-08	2E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-95
Exposure and Risk Estimates Associated With Inhalation of Soil-Derives Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Current Student risks at Capuano School
Ambient Air

Receptor:

Student (4 yr old)

Medium of Origin:

Soil

Exposure Medium:

Ambient Air

Exposure Area:

Future

Depth:

0-15 feet

Duration:

Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/yr	208	
EP	Outdoor Air Exposure Period - Cancer - Particulates	yr	2	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	yr	2	
ATC	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	730	
BW	Body Weight	kg	16	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFFc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	4.9E-02	1.6E-09	0.43	0.000015	0.0007	0.13	1	2E-12	8E-12	1E-13	7E-12	9E-13	1	8E-11	3E-10	7E-10	2E-10	4E-07	1E-12	4E-07
Chloroethane	1.2E-01	3.8E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	2E-10	7E-10	7E-11	6E-10	2E-09	NA	2E-09
Chloroform	4.9E-02	1.6E-09	0.66	0.000023	0.01	NA	1	2E-12	8E-12	2E-13	7E-12	NA	1	8E-11	3E-10	4E-10	2E-10	2E-08	2E-13	3E-08
Dichloroethane, 1,1-	1.3E-01	4.2E-09	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	2E-10	8E-10	2E-09	7E-10	7E-09	NA	8E-09
Dichloroethane, cis-1,2-	4.9E-02	1.6E-09	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	8E-11	3E-10	8E-09	2E-08	2E-08	NA	3E-08
Dichloroethane, 1,1-	4.9E-02	1.6E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	8E-11	3E-10	1E-09	2E-10	5E-09	NA	6E-09
Tetrachloroethene	9.9E-01	3.2E-08	4.6	0.00001	0.01	0.051	1	5E-11	2E-10	2E-12	1E-10	7E-12	1	2E-09	6E-09	1E-09	5E-09	5E-07	9E-12	5E-07
Trans-1,2-Dichloroethene	4.9E-02	1.6E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	8E-11	3E-10	4E-09	2E-10	1E-08	NA	2E-08
Trichloroethane, 1,1,1-	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	1E-13	5E-11	6E-13	1	1E-10	5E-10	9E-11	4E-10	4E-09	NA	4E-09
Trichloroethane	3.6E-01	1.1E-08	0.18	0.0000017	0.002	0.011	1	2E-11	6E-11	7E-14	7E-12	1E-11	1	6E-10	2E-09	1E-08	2E-09	9E-07	7E-13	9E-07
Vinyl chloride	4.9E-02	1.6E-09	0.1	0.0000088	0.003	1.4	1	2E-12	8E-12	2E-12	7E-12	2E-11	1	8E-11	3E-10	3E-09	2E-10	8E-08	1E-11	8E-08
Total																3E-08		2E-06		2E-06

NA - Not available
NC - Not calculated
ND - Not detected

Table A-96
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current Student risks at Capuano School
Ambient Air
Volatilization from Ambient Air

Receptor:	Student (4 yr old)	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	208	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	2	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	2	
ATc	Outdoor Air Averaging Time - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	730	
C	Conversion Factor	ug/mg	1000	

Compound	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane,1,1-	4.7E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene,1,1-	4.6E-04	0.2	NA	1	NA	NA	1	9E-05	4E-04	NA	4E-04
Tetrachloroethene	8.2E-04	4.6	0.00001	1	4E-06	4E-08	1	2E-04	3E-05	4E-08	3E-05
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane,1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.4E-04	0.18	0.0000017	1	3E-06	6E-09	1	1E-04	7E-04	6E-09	7E-04
Vinyl chloride	3.0E-04	0.1	0.0000088	1	2E-06	1E-08	1	6E-05	6E-04	1E-08	6E-04
Total						6E-08			6E-03	6E-08	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-97
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
Unifirst
Future Resident at other streets
Soil

Receptor:	▼
Medium:	▼
Exposure Area:	▼
Depth:	▼
Duration:	▼

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
IRsoilTWA	Soil TWA Ingestion Rate	mg-y/kg-d	64	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2431	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-cm2	659	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	150	
EPc	Soil Exposure Period - Cancer	y	30	
EPnc	Soil Exposure Period - Non-Cancer	y	7	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	2555	
BW	Body Weight	kg	17	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$
$$ADD_{der-nc} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times TWA \times RAF_{os} \times EF}$$
$$ADD_{ing-c} = \frac{C_{soil} \times CF \times IR_{soil} \times SATWA \times RAF_{ds} \times EF}{AP}$$
$$ADD_{der-c} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF}{AP}$$
$$HI_{ing} = \frac{ADD_{ing-nc}}{RfD}$$
$$HI_{der} = \frac{ADD_{der-nc}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing-c} \times CSF$$
$$Risk_{der} = ADD_{der-c} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total					
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsnc	ADDder-c mg/kg-d	Riskder	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A
Carbon tetrachloride Chloroform Dichloroethane, 1,1- Dichloroethene, cis-1,2- Dichloroethene, 1,1- Tetrachloroethene Trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride	3.7E-02	0.0007	0.13	1	1E-08	2E-09	1	9E-08	1E-04	0.1	2E-09	8E-08	1E-04	4E-09	2E-04
	3.7E-02	0.01	NA	NA	NA	NA	1	9E-08	9E-06	NA	NA	8E-08	8E-06	NA	2E-05
	4.3E-01	0.1	NA	NC	NA	NA	1.3	1E-06	1E-05	NC	NA	1E-06	1E-05	NA	3E-05
	7.7E-01	0.01	NA	NC	NA	NA	1	2E-06	2E-04	NC	NA	2E-06	2E-04	NA	3E-04
	4.9E-01	0.05	NA	NC	NA	NA	1	1E-06	2E-05	NC	NA	1E-06	2E-05	NA	4E-05
	5.9E+01	0.01	0.051	1	2E-05	1E-06	1	1E-04	1E-02	0.1	1E-06	1E-04	1E-02	2E-06	3E-02
	3.7E-02	0.02	NA	NC	NA	NA	1	9E-08	4E-06	NC	NA	8E-08	4E-06	NA	8E-06
	7.7E-02	0.09	NA	NC	NA	NA	1	2E-07	2E-06	NC	NA	2E-07	2E-06	NA	4E-06
	6.2E+00	0.002	0.011	1	2E-06	3E-08	1	1E-05	7E-03	0.1	3E-08	1E-05	6E-03	5E-08	1E-02
	3.7E-02	0.003	1.4	1.53	2E-08	3E-08	1	9E-08	3E-05	0.16	3E-08	8E-08	3E-05	6E-08	6E-05
Total						1E-06			2E-02		1E-06		2E-02	2E-06	4E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-98
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
UnFirst
Future Resident at other streets
Ambient Air

Receptor:	Resident	▼
Medium of Origin:	Soil	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	0-15 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-hg	0.6	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	h/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	150	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	30	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	7	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	2555	
BW	Body Weight	kg	17	
G	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$
$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFInc	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	3.7E-02	1.2E-09	0.43	0.000015	0.0007	0.13	1	2E-11	6E-11	9E-13	7E-11	9E-12	1	4E-11	1E-10	3E-10	1E-10	2E-07	1E-11	2E-07
Chloroform	3.7E-02	1.2E-09	0.66	0.000023	0.01	NA	1	2E-11	6E-11	1E-12	NA	NA	1	4E-11	1E-10	2E-10	1E-10	1E-08	1E-12	1E-08
Dichloroethane, 1,1-	4.3E-01	1.4E-08	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	5E-10	2E-09	3E-09	1E-09	1E-08	NA	2E-08
Dichloroethene, cis-1,2-	7.7E-01	2.5E-08	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	9E-10	3E-09	9E-08	3E-09	3E-07	NA	3E-07
Dichloroethene, 1,1-	4.9E-01	1.6E-08	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	5E-10	2E-09	1E-08	2E-09	3E-08	NA	4E-08
Tetrachloroethene	5.9E+01	1.9E-06	4.6	0.00001	0.01	0.051	1	3E-08	9E-08	9E-10	1E-07	5E-09	1	7E-08	2E-07	5E-08	2E-07	2E-05	6E-09	2E-05
Trans-1,2-Dichloroethene	3.7E-02	1.2E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	4E-11	1E-10	2E-09	1E-10	6E-09	NA	8E-09
Trichloroethane, 1,1,1-	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	1E-08	2E-11	1E-08	1E-10	1	9E-11	3E-10	6E-11	3E-09	3E-09	NA	3E-09
Trichloroethene	6.2E+00	2.0E-07	0.18	0.0000017	0.002	0.011	1	3E-09	1E-08	5E-13	7E-11	9E-11	1	7E-09	2E-08	1E-09	2E-08	1E-05	1E-10	1E-05
Vinyl chloride	3.7E-02	1.2E-09	0.1	0.0000088	0.003	1.4	1	2E-11	6E-11	9E-10	NA	6E-09	1	4E-11	1E-10	1E-09	1E-10	4E-08	9E-11	4E-08
Total										9E-10		6E-09				3E-07		3E-05	7E-09	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-99
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other streets
Ambient Air

Receptor:	Resident
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365d / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	150	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	7	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	30	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	2555	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Data	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	NA	0.5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	6E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-	4.6E-04	0.2	NA	1	NA	NA	1	6E-05	3E-04	NA	3E-04
Tetrachloroethene	8.2E-04	4.6	0.00001	1	5E-05	5E-07	1	1E-04	2E-05	5E-07	2E-05
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	6E-05	9E-04	NA	9E-04
Trichloroethane, 1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	9E-05	2E-05	NA	2E-05
Trichloroethene	6.4E-04	0.18	0.0000017	1	4E-05	6E-08	1	9E-05	5E-04	6E-08	5E-04
Vinyl chloride	3.0E-04	0.1	0.0000088	1	2E-05	2E-07	1	4E-05	4E-04	2E-07	4E-04
Total						7E-07			4E-03	7E-07	4E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-100
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other Streets
Indoor Air
163 Glen Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	163 Glen Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.7E-03	4.6	0.00001	1	7E-04	7E-06	1	2E-03	4E-04	7E-06	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	7.6E-04	5.2	NA	NC	NA	NA	1	8E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						9E-06			3E-02	9E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-101
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other Streets
Indoor Air
85 Washington Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	85 Washington Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		1.0E-03	4.6	0.00001	1	4E-04	4E-06	1	1E-03	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene		5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride		2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							6E-06			3E-02	6E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-102
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other Streets
Indoor Air
91-95 Washington Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	91-95 Washington Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethane, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-03	2E-03	NA	2E-03
Tetrachloroethene	4.0E-03	4.6	0.00001	1	2E-03	2E-05	1	4E-03	9E-04	2E-05	9E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						2E-05			3E-02	2E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-103
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other Streets
Indoor Air
97 Washington Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	97 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		1.4E-03	4.6	0.00001	1	6E-04	6E-06	1	1E-03	3E-04	6E-06	3E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		7.8E-04	5.2	NA	NC	NA	NA	1	8E-04	2E-04	NA	2E-04
Trichloroethene		5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride		2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							7E-06			3E-02	7E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-104
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Resident at other Streets
Indoor Air
121 Washington Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	121 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.3E-03	4.6	0.00001	1	5E-04	5E-06	1	1E-03	3E-04	5E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	8.2E-04	5.2	NA	NC	NA	NA	1	8E-04	2E-04	NA	2E-04
Trichloroethene	5.5E-04	0.18	0.000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						7E-06			3E-02	7E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-105
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at other streets
Soil

Receptor:	Commercial/Industrial Worker
Medium:	Soil
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_d \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	50	
IR _{soil} TWA	Soil TWA Ingestion Rate	mg-y/kg-d	0	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
SATWA	Soil TWA Dermal Contact Skin Exposed	mg-cm2-y/kg-d-cm2	0	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.03	
EF	Soil Exposure Frequency	d/y	120	
EP _c	Soil Exposure Period - Cancer	y	27	
EP _{nc}	Soil Exposure Period - Non-Cancer	y	27	
AT _c	Soil Averaging Time - Cancer	d	25550	
AT _n	Soil Averaging Time - Non-Cancer	d	9855	
BW	Body Weight	kg	61	
CF	Conversion Factor	kg/mg	0.000001	

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride Chloroethane Chloroform Dichloroethane, 1,1- Dichloroethene, cis-1,2- Dichloroethene, 1,1- Tetrachloroethene trans-1,2-Dichloroethene Trichloroethane, 1,1,1- Trichloroethene Vinyl chloride	3.7E-02	0.0007	0.13	1	4E-09	5E-10	1	1E-08	1E-05	0.1	8E-10	1E-10	0.1	2E-09	3E-06	6E-10	2E-05
	9.5E-02	0.4	NA	NC	NA	NA	1	3E-08	6E-08	NC	NA	NA	0.1	5E-09	1E-08	NA	8E-08
	3.7E-02	0.01	NA	NA	NA	NA	1	1E-08	1E-06	NA	NA	NA	0.1	2E-09	2E-07	NA	1E-06
	4.3E-01	0.1	NA	NC	NA	NA	1.3	2E-07	2E-06	NC	NA	NA	0.13	3E-08	3E-07	NA	2E-06
	7.7E-01	0.01	NA	NC	NA	NA	1	2E-07	2E-05	NC	NA	NA	0.1	4E-08	4E-06	NA	3E-05
	4.9E-01	0.05	NA	NC	NA	NA	1	1E-07	3E-06	NC	NA	NA	0.1	3E-08	6E-07	NA	3E-06
	5.9E+01	0.01	0.051	1	6E-06	3E-07	1	2E-05	2E-03	0.1	1E-06	6E-08	0.1	3E-06	3E-04	4E-07	2E-03
	3.7E-02	0.02	NA	NC	NA	NA	1	1E-08	5E-07	NC	NA	NA	0.1	2E-09	1E-07	NA	6E-07
	7.7E-02	0.09	NA	NC	NA	NA	1	2E-08	2E-07	NC	NA	NA	0.1	4E-09	5E-08	NA	3E-07
6.2E+00	0.002	0.011	1	6E-07	7E-09	1	2E-06	8E-04	0.1	1E-07	1E-09	0.1	3E-07	2E-04	9E-09	1E-03	
3.7E-02	0.003	1.4	1.53	6E-09	8E-09	1	1E-08	3E-06	0.16	1E-09	2E-09	0.1	2E-09	7E-07	1E-08	4E-06	
Total						3E-07			2E-03			7E-08			5E-04	4E-07	3E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-106
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Commercial Worker at other streets
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	0-15 feet
Duration:	Chronic

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	1	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	dy	120	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	27	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	9855	
BW	Body Weight	kg	61	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi-c} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-gi-nc} = \frac{C_{air} \times 1.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADD_{inh-c} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_{ic} \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh-nc} = \frac{C_{air} \times 0.5 \times IR_{air} \times TWA \times RAF_{inc} \times ET \times EF \times C}{AP}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$

$$HI = \frac{ADD_{inh-gi-nc}}{RfD} + \frac{ADE_{inh-nc}}{RfC}$$

$$Risk = (ADD_{inh-gi-c} \times CSF) + (ADE_{inh-c} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFic	ADD-ihnc mg/kg-d	ADE-nc mg/m3	HIinh	ADD-ihnc	Hiling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	3.7E-02	1.2E-09	0.43	0.000015	0.0007	0.13	1	1E-11	4E-11	6E-13	4E-11	1E-07	5E-12	1E-07
Chloroethane	9.5E-02	3.0E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	6E-10	NA	6E-10
Chloroform	3.7E-02	1.2E-09	0.66	0.000023	0.01	NA	1	1E-11	4E-11	9E-13	9E-11	9E-09	9E-13	9E-09
Dichloroethane, 1,1-	4.3E-01	1.4E-08	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	1E-08	NA	1E-08
Dichloroethane, dis-1,2-	7.7E-01	2.5E-08	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	2E-07	NA	3E-07
Dichloroethene, 1,1-	4.9E-01	1.6E-08	0.2	NA	0.05	NA	1	NA	NA	NA	1E-09	2E-08	NA	3E-08
Tetrachloroethene	5.9E+01	1.9E-06	4.6	0.00001	0.01	0.051	1	2E-08	7E-08	7E-10	6E-08	1E-05	4E-09	1E-05
Trans-1,2-Dichloroethene	3.7E-02	1.2E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	2E-07	5E-09	NA	6E-09
Trichloroethane, 1,1,1-	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	2E-10	2E-09	NA	2E-09
Trichloroethene	6.2E+00	2.0E-07	0.18	0.0000017	0.002	0.011	1	2E-09	7E-09	1E-11	6E-09	8E-06	8E-11	8E-06
Vinyl chloride	3.7E-02	1.2E-09	0.1	0.0000088	0.003	1.4	1	1E-11	4E-11	4E-13	9E-11	3E-08	5E-11	3E-08
Total										7E-10		2E-05	4E-09	2E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-107
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Commercial Worker at other streets
Ambient Air

Receptor:	Commercial/Industrial Worker
Medium of Origin:	Ambient Air
Exposure Medium:	Ambient Air
Exposure Area:	Future
Depth:	Shallow
Duration:	Chronic

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	120	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	27	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	27	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	9855	
C	Conversion Factor	ug/mg	1000	

Compound	OUTDOOR AIR DATA					Risk (Ambient Air)					HI (Ambient Air)	
	Ambient Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh			
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	4.7E-04	0.5	NA	NC	NA	NA	1	5E-05	1E-04	NA	1E-04	NA
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	5E-05	1E-03	NA	1E-03	NA
Dichloroethene, 1,1-	4.6E-04	0.2	NA	1	NA	NA	1	5E-05	3E-04	NA	3E-04	NA
Tetrachloroethene	8.2E-04	4.6	0.00001	1	3E-05	3E-07	1	9E-05	2E-05	3E-07	2E-05	NA
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	5E-05	7E-04	NA	7E-04	NA
Trichloroethane, 1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	7E-05	1E-05	NA	1E-05	NA
Trichloroethene	6.4E-04	0.18	0.0000017	1	3E-05	5E-08	1	7E-05	4E-04	5E-08	4E-04	NA
Vinyl chloride	3.0E-04	0.1	0.0000088	1	1E-05	1E-07	1	3E-05	3E-04	1E-07	3E-04	NA
Total						5E-07			3E-03	5E-07	3E-03	

NA - Not available
NC - Not calculated
ND - Not detected

Table A-108
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Future Student risks at schools on other streets
Soil

Receptor:	Student (4 yr old)	▼
Medium:	Soil	▼
Exposure Area:	Future	▼
Depth:	0-15 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm2/d	2495	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.35	
EF	Soil Exposure Frequency	d/y	208	
EPC	Soil Exposure Period - Cancer	y	2	
EPnc	Soil Exposure Period - Non-Cancer	y	2	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	730	
BW	Body Weight	kg	16	
CF	Conversion Factor	kg/mg	0.000001	

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$
$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$
$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$
$$HI_{der} = \frac{ADD_{der}}{RfD}$$
$$HI = HI_{ing} + HI_{der}$$
$$Risk_{ing} = ADD_{ing} \times CSF$$
$$Risk_{der} = ADD_{der} \times CSF$$
$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Soil (mg/kg)	RID (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total							
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosnc	ADDing-nc mg/kg-d	Hling	RAFdsc	ADDder-c mg/kg-d	Riskder	RAFdsnc	ADDder-nc mg/kg-d	Hlder	Risk (Soil) YC-OC-A	HI (Soil) YC
Carbon tetrachloride	3.7E-02	0.0007	0.13	1	4E-09	5E-10	1	1E-07	2E-04	0.1	3E-09	4E-10	0.1	1E-07	2E-04	9E-10	3E-04
Chloroethane	9.5E-02	0.4	NA	NC	NA	NA	1	3E-07	8E-07	NC	NA	NA	0.1	3E-07	7E-07	NA	2E-06
Chloroform	3.7E-02	0.01	NA	NA	NA	NA	1	1E-07	1E-05	NA	NA	NA	0.1	1E-07	1E-05	NA	2E-05
Dichloroethane, 1,1-	4.3E-01	0.1	NA	NC	NA	NA	1.3	2E-06	2E-05	NC	NA	NA	0.13	2E-06	2E-05	NA	4E-05
Dichloroethene, cis-1,2-	7.7E-01	0.01	NA	NC	NA	NA	1	3E-06	3E-04	NC	NA	NA	0.1	2E-06	2E-04	NA	5E-04
Dichloroethene, 1,1-	4.9E-01	0.05	NA	NC	NA	NA	1	2E-06	3E-05	NC	NA	NA	0.1	1E-06	3E-05	NA	6E-05
Tetrachloroethene	5.9E+01	0.01	0.051	1	6E-06	3E-07	1	2E-04	2E-02	0.1	5E-06	3E-07	0.1	2E-04	2E-02	6E-07	4E-02
Trans-1,2-Dichloroethene	3.7E-02	0.02	NA	NC	NA	NA	1	1E-07	6E-06	NC	NA	NA	0.1	1E-07	6E-06	NA	1E-05
Trichloroethane, 1,1,1-	7.7E-02	0.09	NA	NC	NA	NA	1	3E-07	3E-06	NC	NA	NA	0.1	2E-07	3E-06	NA	6E-06
Trichloroethene	6.2E+00	0.002	0.011	1	6E-07	7E-09	1	2E-05	1E-02	0.1	5E-07	6E-09	0.1	2E-05	9E-03	1E-08	2E-02
Vinyl chloride	3.7E-02	0.003	1.4	1.53	6E-09	8E-09	1	1E-07	4E-05	0.16	5E-09	7E-09	0.1	1E-07	4E-05	2E-08	8E-05
Total						3E-07			3E-02			3E-07			3E-02	6E-07	6E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-109
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
UniFirst
Future Student risks at schools on other streets
Ambient Air

Receptor:	Student (4 yr old)	▼
Medium of Origin:	Soil	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	0-15 feet	▼
Duration:	Chronic	▼

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	0.4	
PEF	Outdoor Air PM10 - Particulates	ug/m3	32	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	208	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	2	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	2	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	730	
BW	Body Weight	kg	16	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$

$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$

$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-Ingc	RiskIng	RAFinC	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-Ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	3.7E-02	1.2E-09	0.43	0.000015	0.0007	0.13	1	2E-12	6E-12	9E-14	5E-12	7E-13	1	6E-11	2E-10	5E-10	2E-10	3E-07	8E-13	3E-07
Chloroethane	9.5E-02	3.0E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	2E-10	6E-10	6E-11	5E-10	1E-09	NA	1E-09
Chloroform	3.7E-02	1.2E-09	0.66	0.000023	0.01	NA	1	2E-12	6E-12	1E-13	5E-12	NA	1	6E-11	2E-10	3E-10	2E-10	2E-08	1E-13	2E-08
Dichloroethane, 1,1-	4.3E-01	1.4E-08	0.5	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	7E-10	3E-09	5E-09	2E-09	2E-08	NA	3E-08
Dichloroethane, cis-1,2-	7.7E-01	2.5E-08	0.035	NA	0.01	NA	NC	NA	NA	NA	NA	NA	1	1E-09	5E-09	1E-07	4E-09	4E-07	NA	5E-07
Dichloroethene, 1,1-	4.9E-01	1.6E-08	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	8E-10	3E-09	1E-08	2E-09	5E-08	NA	6E-08
Tetrachloroethene	5.9E+01	1.9E-06	4.6	0.00001	0.01	0.051	1	3E-09	1E-08	1E-10	9E-09	4E-10	1	1E-07	3E-07	8E-08	3E-07	3E-05	5E-10	3E-05
Trans-1,2-Dichloroethene	3.7E-02	1.2E-09	0.07	NA	0.02	NA	NC	NA	NA	NA	NA	NA	1	6E-11	2E-10	3E-09	2E-10	9E-09	NA	1E-08
Trichloroethane, 1,1,1-	7.7E-02	2.5E-09	5.2	NA	0.09	NA	NC	NA	NA	NA	NA	NA	1	1E-10	5E-10	9E-11	4E-10	4E-09	NA	4E-09
Trichloroethene	6.2E+00	2.0E-07	0.18	0.0000017	0.002	0.011	1	3E-10	1E-09	2E-12	9E-10	1E-11	1	1E-08	4E-08	2E-07	3E-08	2E-05	1E-11	2E-05
Vinyl chloride	3.7E-02	1.2E-09	0.1	0.0000088	0.003	1.4	1	2E-12	6E-12	6E-14	5E-12	8E-12	1	6E-11	2E-10	2E-09	2E-10	6E-08	8E-12	6E-08
Total										1E-10		5E-10				4E-07		5E-05		5E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-110

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Future Student risks at schools on other streets
Ambient Air
Volatilization from Ambient Air

Receptor:	Student (4 yr old)	▼
Medium of Origin:	Ambient Air	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Future	▼
Depth:	Shallow	▼
Duration:	Chronic	▼

$$C_{air} = \frac{C_{source} \times VF}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24hr / d \times 365 d / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	208	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	2	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	2	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	730	
C	Conversion Factor	ug/mg	1000	

Compound	Outdoor Air Data	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Ambient Air)	HI (Ambient Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.7E-04	0.5	NA	NC	NA	NA	1	9E-05	2E-04	NA	2E-04
Dichloroethene, cis-1,2-	4.6E-04	0.035	NA	NC	NA	NA	1	9E-05	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.6E-04	0.2	NA	1	NA	NA	1	9E-05	4E-04	NA	4E-04
Tetrachloroethene	8.2E-04	4.6	0.00001	1	4E-06	4E-08	1	2E-04	3E-05	4E-08	3E-05
Trans-1,2-Dichloroethene	4.6E-04	0.07	NA	NC	NA	NA	1	9E-05	1E-03	NA	1E-03
Trichloroethane, 1,1,1-	6.4E-04	5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene	6.4E-04	0.18	0.0000017	1	3E-06	6E-09	1	1E-04	7E-04	6E-09	7E-04
Vinyl chloride	3.0E-04	0.1	0.0000088	1	2E-06	1E-08	1	6E-05	6E-04	1E-08	6E-04
Total						6E-08			6E-03	6E-08	6E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-111
Exposure and Risk Estimates Associated With Soil Contact
50 Tutts Street, Somerville MA
UniFirst
Construction Worker at other streets
Soil - Dermal contact & Incidental Ingestion

Receptor:	Construction Worker
Medium:	Surface Soil
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{os} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IR _{soil}	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm ² /d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm ²	0.29	
EF	Soil Exposure Frequency	d/y	130	
EP	Soil Exposure Period - Cancer	y	1	
EP	Soil Exposure Period - Non-Cancer	y	1	
ATc	Soil Exposure Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	182	
BW	Soil Averaging Time - Non-Cancer	kg	58	
CF	Body Weight	kg/mg	0.000001	
	Conversion Factor			

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total Risk (Soil)	HI (Soil)
				RAFosc	ADDing-c mg/kg-d	Risking	RAFosc	ADDing-nc mg/kg-d	Hling		
Carbon tetrachloride	3.7E-02	0.007	0.13	1	3E-10	4E-11	1	5E-08	7E-06	8E-11	1E-05
Chloroethane	9.5E-02	0.4	NA	NC	NA	NA	1	1E-07	3E-07	NA	6E-07
Chloroform	3.7E-02	0.01	NA	NC	NA	NA	1	5E-08	5E-06	NA	9E-06
Dichloroethane, 1,1-	4.3E-01	1	NA	NC	NA	NA	1.3	7E-07	7E-07	NA	1E-06
Dichloroethane, cis-1,2-	7.7E-01	0.1	NA	NC	NA	NA	1	1E-06	1E-05	NA	2E-05
Dichloroethane, 1,1-	4.9E-01	0.05	NA	NC	NA	NA	1	6E-07	1E-05	NA	2E-05
Tetrachloroethene	5.9E+01	0.1	0.051	1	5E-07	3E-08	1	7E-05	7E-04	5E-08	1E-03
Trans-1,2-Dichloroethene	3.7E-02	0.2	NA	NC	NA	NA	1	5E-08	2E-07	NA	5E-07
Trichloroethane, 1,1,1-	7.7E-02	0.9	NA	NC	NA	NA	1	9E-08	1E-07	NA	2E-07
Trichloroethene	6.2E+00	0.02	0.011	1	5E-08	6E-10	1	8E-06	4E-04	1E-09	8E-04
Vinyl chloride	3.7E-02	0.003	1.4	1.53	5E-10	7E-10	1	5E-08	2E-05	1E-09	3E-05
Total						3E-08			1E-03	6E-08	2E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-112
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates in Air
50 Tufts Street, Somerville MA
Unifirst
Construction Worker at other streets
Ambient Air

Receptor:	Construction Worker
Medium of Origin:	Soil
Exposure Medium:	Ambient Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = C_{soil} \times PM^{10}$$

$$ADD_{inh-g} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$

$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3/d}$$

$$HI = \frac{ADD_{inh-g}}{RfD} + \frac{ADE_{inh}}{RfC}$$

$$Risk = (ADD_{inh-g} \times CSF) + (ADE_{inh} \times URF \times C)$$

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRairTWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	130	
EP	Outdoor Air Exposure Period - Particulates	y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	182	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFiC	ADD-inhC mg/kg-d	ADE-inC mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	3.7E-02	2.2E-09	0.43	0.000015	0.007	0.13	1	3E-12	1E-11	1E-13	8E-12	1E-12	1E-12	2E-07
Chloroethane	9.5E-02	5.7E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	8E-09	NA	8E-09
Chloroform	3.7E-02	2.2E-09	0.66	0.000023	0.01	NA	1	3E-12	1E-11	2E-13	NA	2E-13	2E-13	1E-07
Dichloroethane, 1,1-	4.3E-01	2.6E-08	5	NA	1	NA	NC	NA	NA	NA	NA	1E-08	NA	2E-08
Dichloroethane, cis-1,2-	7.7E-01	4.6E-08	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	2E-07	NA	1E-06
Dichloroethane, 1,1-	4.9E-01	2.9E-08	0.2	NA	0.05	NA	1	4E-09	2E-08	2E-10	1E-08	2E-07	NA	4E-07
Tetrachloroethene	5.9E+01	3.5E-06	4.6	0.000001	0.1	0.051	NC	NA	NA	NA	NA	8E-10	NA	2E-05
Trans-1,2-Dichloroethene	3.7E-02	2.2E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	6E-09	NA	8E-09
Trichloroethane, 1,1,1-	7.7E-02	4.6E-09	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	3E-09	NA	3E-08
Trichloroethene	6.2E+00	3.7E-07	0.18	0.0000017	0.02	0.011	1	5E-10	2E-09	3E-12	1E-09	1E-05	2E-11	1E-05
Vinyl chloride	3.7E-02	2.2E-09	0.1	0.0000088	0.003	1.4	1	3E-12	1E-11	9E-14	8E-12	1E-11	1E-11	4E-07
Total										2E-10		3E-05	9E-10	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-113
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at other streets

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H _{Ts}	Deff Vadose Zone (Layer A + Layer B)	Deff Total (Layer A + Layer B + Layer C)	Deffcrack (Layer A)	Exponent of Peclet Number	Organic Carbon- Water Partition Coefficient Koc	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.5E+02	1.53E-03	6.95E-03	9.35E-05	6.13E-06	3.91E-02	2.56E-03
Chloroethane	4.77E-01	5.35E-02	3.80E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.64E-02	3.25E-04	2.13E-05	1.10E-01	7.21E-03
Chloroform	8.04E-02	2.05E-02	1.46E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	5.06E-03	1.25E-04	8.17E-06	7.13E-03	4.67E-04
Dichloroethane, 1,1-	1.24E-01	1.46E-02	1.04E-02	1.46E-02	2.74E+109	5.3E+01	1.15E-03	5.25E-03	8.89E-05	5.83E-06	7.86E-03	5.15E-04
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	1.03E-02	1.45E-02	2.13E+110	3.6E+01	1.17E-03	5.34E-03	8.82E-05	5.78E-06	5.52E-03	3.62E-04
Dichloroethene, 1,1-	6.34E-01	1.78E-02	1.26E-02	1.78E-02	1.68E+90	6.5E+01	2.51E-03	1.14E-02	1.08E-04	7.07E-06	4.86E-02	3.18E-03
Tetrachloroethene	3.24E-01	1.42E-02	1.01E-02	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.83E-03	8.63E-05	5.65E-06	1.99E-02	1.30E-03
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	9.91E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	7.75E-03	8.48E-05	5.55E-06	1.28E-02	8.42E-04
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	1.09E-02	1.54E-02	1.28E+104	1.4E+02	1.29E-03	5.85E-03	9.35E-05	6.13E-06	2.43E-02	1.59E-03
Trichloroethene	1.97E-01	1.56E-02	1.11E-02	1.56E-02	6.13E+102	9.4E+01	1.14E-03	5.18E-03	9.47E-05	6.20E-06	1.33E-02	8.70E-04
Vinyl chloride	7.65E-01	2.09E-02	1.49E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	2.14E-02	1.27E-04	8.32E-06	6.91E-02	4.52E-03

Table A-114
Site-specific Parameters for Volatilization Calculations
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at other streets

Symbol	(units)	Parameter	Value	Comment
L_{crack}	(cm)	Thickness of foundation	15	
f_{OC}	(g/g)	Fraction organic carbon in vadose zone soil	0.02	
L_f	(15 or 200 cm)	Depth below grade to bottom of enclosed space floor	15	Input either 15 or 200
L_{wt}	(cm)	Depth below grade to water table	462	15.16 Ft.
T_s	Kelvin	Average soil/ groundwater temperature	283	10 (°C)
L_f	(cm)	Source- building separation	447	
L_b	(cm)	Length of building	961	DEP Default
W_b	(cm)	Width of building	961	DEP Default
H_b	(cm)	Height of building	488	DEP Default
X_{crack}	(cm)	Floor- wall seam perimeter	3.84E+03	
ER	(1/hr)	Air exchange rate	0.45	DEP Default
$Q_{building}$	(cm ² /s)	Bldg. ventilation rate	5.63E+04	
A_g	(cm ²)	Area of enclosed space below grade	9.24E+05	
η	(unitless)	Crack- to-total area ratio	4.16E-04	
Z_{crack}	(cm)	Crack depth below grade	15	
μ_{TS}	(g/cm-s)	Vapor viscosity at ave. soil temperature	1.75E-04	
L_p	(cm)	Diffusion path length	447	
L_p	(cm)	Convection path length	15	
f_{crack}	(cm)	Crack radius	0.10	DEP Default
ΔP	g/cm-s ²	Pressure differential between soil surface and enclosed space	40	DEP Default
Q_{soil}	(cm ³ /s)	Average vapor flow rate into bldg.	9.45E+01	
A_{crack}	(cm ²)	Area of crack	384	
Rc	(cal/mol-K)	Gas constant	1.99	
R	(atm-m3/mol-K)	Universal gas constant	8.21E-05	
R2	(mmHg-cm3/mol-K)	Universal gas constant	6.24E+04	
W_{SA}	(cm)	Width of soil source to ambient air	1.52E+03	50 Ft.
t_{SA}	(s)	Averaging time for volatilization from soil to ambient air	1.58E+07	0.5 y
U	(cm/s)	Wind speed	225	
D	(cm)	Mixing height	183	6 Ft.
Z_s	(cm)	Depth to soil source	462	15.16 Ft.
Z_{SG}	(cm)	Depth to soil gas source	462	15.16 Ft.
W_E	(cm)	Width of excavation	1524	50 Ft.
L_e	(cm)	Length of excavation	762	25 Ft.
H_e	(cm)	Height of excavation	457	15 Ft.
W_{Ec}	(cm)	Width of excavation that is contaminated	1524	50 Ft.
L_{Ec}	(cm)	Length of excavation that is contaminated	762	25 Ft.
H_{Ec}	(cm)	Height of excavation that is contaminated	457	15 Ft.
WT	(cm)	Width of trench	457	15 Ft.
LT	(cm)	Length of trench	122	4 Ft.
HT	(cm)	Height of trench	183	6 Ft.
WTC	(cm)	Width of trench that is contaminated	457	15 Ft.
LTC	(cm)	Length of trench that is contaminated	122	4 Ft.
HTC	(cm)	Height of trench that is contaminated	183	6 Ft.
t_{SE}	(s)	Averaging time for volatilization from soil to excavation	1.58E+07	0.5 y
t_{ST}	(s)	Averaging time for volatilization from soil to trench	3.15E+07	1 y
F_E	(unitless)	Fraction of wind speed that occurs in excavation	0.5	
F_T	(unitless)	Fraction of wind speed that occurs in trench	0.1	
d	(cm)	Lower depth of surface soil source	462	15.16 Ft.
P_b	(g/cm ³)	Vadose zone soil dry bulk density	1.5	Vadose Zone Layer A
n	(unitless)	Vadose zone soil total porosity	1.5	Vadose Zone Layer B
θ_w	(cm ³ /cm ³)	Vadose zone soil water-filled porosity	0.43	Capillary Zone
θ_a	(cm ³ /cm ³)	Vadose zone soil air-filled porosity	0.06	
h	(cm)	Thickness of soil layer	0.37	
S_{so}	(cm ³ /cm ³)	Vadose zone effective total fluid saturation	0.37	
k_i	(cm ²)	Vadose zone soil intrinsic permeability	15	
k_{rg}	(cm ²)	Vadose zone soil relative air permeability	415	
k_v	(cm ²)	Vadose zone soil effective vapor permeability	0.019	
			9.92E-08	
			0.99	
			9.79E-08	

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building Sand

Capillary zone Sand

Key:
Type In Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Values Assume all sources are 1 inch below excavation depth

Table A-115
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at other streets
Excavation Air
Volatilization from Soil Gas

Receptor:	Construction Worker	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil Gas mg/m3	Alpha Volatilization from Soil Gas to Excavation Air (mg/m3 excav) / (mg/m3 SG)	Source Dilution Factor	EPC (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiC	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	8.7E-01	9.35E-05	1	8.1E-05	0.43	0.000015	1	1E-07	2E-09	1	1E-05	2E-05	2E-09	2E-05
Chloroethane	3.6E-01	3.25E-04	1	1.2E-04	10	NA	NC	NA	NA	1	1E-05	1E-06	NA	1E-06
Chloroform	NA	1.25E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	1.0E+00	8.89E-05	1	9.2E-05	5	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Dichloroethene, cis-1,2-	1.7E+00	8.82E-05	1	1.5E-04	0.035	NA	NC	NA	NA	1	2E-05	5E-04	NA	5E-04
Dichloroethene, 1,1-	1.3E+00	1.08E-04	1	1.4E-04	0.2	NA	1	NA	NA	1	2E-05	8E-05	NA	8E-05
Tetrachloroethene	3.3E+02	8.63E-05	1	2.9E-02	4.6	0.00001	1	5E-05	5E-07	1	3E-03	7E-04	5E-07	7E-04
Trans-1,2-Dichloroethene	5.5E-01	8.48E-05	1	4.6E-05	0.7	NA	NC	NA	NA	1	5E-06	8E-06	NA	8E-06
Trichloroethane, 1,1,1-	3.7E+00	9.35E-05	1	3.4E-04	5.2	NA	NC	NA	NA	1	4E-05	8E-06	NA	8E-06
Trichloroethene	2.8E+00	9.47E-05	1	2.7E-04	0.18	0.0000017	1	5E-07	8E-10	1	3E-05	2E-04	8E-10	2E-04
Vinyl chloride	3.5E-01	1.27E-04	1	4.5E-05	0.1	0.0000088	1	8E-08	7E-10	1	5E-06	5E-05	7E-10	5E-05
Total									5E-07			2E-03	5E-07	2E-03

NA - Not available
NC - Not calculated
ND - Not detected

Table A-116
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at other streets
Excavation Air
Volatilization from Subsurface Soil

Receptor:	Construction Worker	▼
Medium of Origin:	Subsurface Soil	▼
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$
$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

	EPC	VF Volatilization from Subsurface Soil to Excavation Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC mg/m3	ADE-c mg/m3	Riskinh	RAFiC mg/m3	ADE-nc mg/m3	Hlinh	Risk (Excavation Air)	HI (Excavation Air)
Compound	Subsurface Soil mg/kg													
Carbon tetrachloride	3.7E-02	1.53E-03	1	5.7E-05	0.43	0.000015	1	1E-07	1E-09	1	7E-06	2E-05	1E-09	2E-05
Chloroethane	9.5E-02	5.80E-03	1	5.5E-04	10	NA	NC	NA	NA	1	7E-05	7E-06	NA	7E-06
Chloroform	3.7E-02	1.11E-03	1	4.1E-05	0.66	0.000023	1	7E-08	2E-09	1	5E-06	7E-06	2E-09	7E-06
Dichloroethane, 1,1-	4.3E-01	1.15E-03	1	5.0E-04	5	NA	NC	NA	NA	1	6E-05	1E-05	NA	1E-05
Dichloroethene, cis-1,2-	7.7E-01	1.17E-03	1	9.1E-04	0.035	NA	NC	NA	NA	1	1E-04	3E-03	NA	3E-03
Dichloroethene, 1,1-	4.9E-01	2.51E-03	1	1.2E-03	0.2	NA	1	NA	NA	1	1E-04	7E-04	NA	7E-04
Tetrachloroethene	5.9E+01	8.42E-04	1	5.0E-02	4.6	0.00001	1	8E-05	8E-07	1	6E-03	1E-03	8E-07	1E-03
Trans-1,2-Dichloroethene	3.7E-02	1.71E-03	1	6.3E-05	0.7	NA	NC	NA	NA	1	7E-06	1E-05	NA	1E-05
Trichloroethane, 1,1,1-	7.7E-02	1.29E-03	1	9.9E-05	5.2	NA	NC	NA	NA	1	1E-05	2E-06	NA	2E-06
Trichloroethene	6.2E+00	1.14E-03	1	7.0E-03	0.18	0.000017	1	1E-05	2E-08	1	8E-04	5E-03	2E-08	5E-03
Vinyl chloride	3.7E-02	4.71E-03	1	1.7E-04	0.1	0.0000088	1	3E-07	3E-09	1	2E-05	2E-04	3E-09	2E-04
Total									9E-07			1E-02	9E-07	1E-02

Table A-117

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA

UniFirst

Construction Worker at other streets

Excavation Air

Volatilization from Groundwater

Receptor:	Construction Worker
Medium of Origin:	Groundwater
Exposure Medium:	Excavation Air
Exposure Area:	Excavation
Depth:	0-15 feet
Duration:	Subchronic

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Groundwater (mg/L)	VF Volatilization from Groundwater to Excavation Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Excavation Air (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiC	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	5.0E-04	3.91E-02	1	2.0E-05	0.43	0.000015	1	3E-08	5E-10	1	2E-06	5E-06	5E-10	5E-06
Chloroethane	1.5E-02	1.10E-01	1	1.6E-03	10	NA	NC	NA	NA	1	2E-04	2E-05	NA	2E-05
Chloroform	8.9E-03	7.13E-03	1	6.4E-05	0.66	0.000023	1	1E-07	2E-09	1	8E-06	1E-05	2E-09	1E-05
Dichloroethane, 1,1-	7.7E-02	7.86E-03	1	6.0E-04	5	NA	NC	NA	NA	1	7E-05	1E-05	NA	1E-05
Dichloroethane, cis-1,2-	2.0E-01	5.52E-03	1	1.1E-03	0.035	NA	NC	NA	NA	1	1E-04	4E-03	NA	4E-03
Dichloroethane, 1,1-	4.3E-02	4.86E-02	1	2.1E-03	0.2	NA	1	NA	NA	1	2E-04	1E-03	NA	1E-03
Tetrachloroethene	6.7E+00	1.99E-02	1	1.3E-01	4.6	0.00001	1	2E-04	2E-06	1	2E-02	3E-03	2E-06	3E-03
Trans-1,2-Dichloroethene	7.6E-03	1.28E-02	1	9.7E-05	0.7	NA	NC	NA	NA	1	1E-05	2E-05	NA	2E-05
Trichloroethane, 1,1,1-	9.1E-02	2.43E-02	1	2.2E-03	5.2	NA	NC	NA	NA	1	3E-04	5E-05	NA	5E-05
Trichloroethene	1.5E-01	1.33E-02	1	2.0E-03	0.18	0.000017	1	3E-06	6E-09	1	2E-04	1E-03	6E-09	1E-03
Vinyl chloride	5.8E-02	6.91E-02	1	4.0E-03	0.1	0.0000088	1	7E-06	6E-08	1	5E-04	5E-03	6E-08	5E-03
Total									2E-06			1E-02	2E-06	1E-02

NA - Not available

NC - Not calculated

ND - Not detected

Table A-118
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Construction Worker at other streets
Excavation Air

Receptor:	Construction Worker	▼
Medium of Origin:		▼ All 3 media
Exposure Medium:	Excavation Air	▼
Exposure Area:	Excavation	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	130	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	1	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	1	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	182	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	Average of 3 media (mg/m3)	0.43	0.000015	1	9E-08	1E-09	1	6E-06	1E-05	1E-09	1E-05
Chloroethane		10	NA	NC	NA	NA	1	9E-05	9E-06	NA	9E-06
Chloroform		0.66	0.000023	1	9E-08	2E-09	1	6E-06	9E-06	2E-09	9E-06
Dichloroethane, 1,1-		5	NA	NC	NA	NA	1	5E-05	9E-06	NA	9E-06
Dichloroethene, cis-1,2-		0.035	NA	NC	NA	NA	1	9E-05	2E-03	NA	2E-03
Dichloroethene, 1,1-		0.2	NA	NC	NA	NA	1	1E-04	7E-04	NA	7E-04
Tetrachloroethene		4.6	0.00001	1	1E-04	1E-06	1	8E-03	2E-03	1E-06	2E-03
Trans-1,2-Dichloroethene		0.7	NA	NC	NA	NA	1	8E-06	1E-05	NA	1E-05
Trichloroethane, 1,1,1-		5.2	NA	NC	NA	NA	1	1E-04	2E-05	NA	2E-05
Trichloroethene		0.18	0.0000017	1	5E-06	9E-09	1	4E-04	2E-03	9E-09	2E-03
Vinyl chloride		0.1	0.0000088	1	2E-06	2E-08	1	2E-04	2E-03	2E-08	2E-03
Total						1E-06			9E-03	1E-06	9E-03

NA - Not available
NC - Not calculated
ND - Not detected
Assumes groundwater is directly beneath the excavation

Table A-119
Exposure and Risk Estimates Associated With Soil Contact
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Soil - Dermal contact & Incidental Ingestion

Receptor:	Utility Worker
Medium:	Surface Soil
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

$$ADD_{ing} = \frac{C_{soil} \times CF \times IR_{soil} \times RAF_{cs} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{soil} \times CF \times SA \times AF \times RAF_{ds} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk_{ing} = ADD_{ing} \times CSF$$

$$Risk_{der} = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Parameter	Definition	Units	Value	Comment
IRsoil	Soil Ingestion Rate	mg/d	100	
SA	Soil Dermal Contact Skin Exposed	cm2/d	3473	
AF	Soil Dermal Contact Adherence Rate	mg/cm2	0.29	
EF	Soil Exposure Frequency	d/y	1	
EP	Soil Exposure Period - Cancer	y	5	
EP	Soil Exposure Period - Non-Cancer	y	5	
ATc	Soil Averaging Time - Cancer	d	25550	
ATn	Soil Averaging Time - Non-Cancer	d	1825	
BW	Body Weight	kg	58	
CF	Conversion Factor	kg/mg	0.000001	

Compound	EPC Soil (mg/kg)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion			Dermal Contact			Total Risk (Soil)	HI (Soil)
				RAFOsc	ADDing-c mg/kg-d	Risking	RAFOsnc	ADDder-nc mg/kg-d	Hlder		
Carbon tetrachloride	2.8E-02	0.007	0.13	1	9E-12	1E-12	1	1E-10	2E-08	2E-12	4E-08
Chloroethane	5.6E-02	0.4	NA	NC	NA	NA	1	3E-10	7E-10	NA	1E-09
Chloroform	2.8E-02	0.01	NA	NA	NA	NA	1	1E-10	1E-08	NA	3E-08
Dichloroethane, 1,1-	1.3E-01	1	NA	NC	NA	NA	1.3	8E-10	8E-10	NA	2E-09
Dichloroethane, cis-1,2-	2.8E-02	0.1	NA	NC	NA	NA	1	1E-10	1E-09	NA	3E-09
Dichloroethane, 1,1-	2.8E-02	0.05	NA	NC	NA	NA	1	1E-10	3E-09	NA	5E-09
Tetrachloroethene	9.9E-01	0.1	0.051	1	3E-10	2E-11	1	5E-09	5E-08	3E-11	9E-08
Trans-1,2-Dichloroethene	2.8E-02	0.2	NA	NC	NA	NA	1	1E-10	7E-10	NA	1E-09
Trichloroethane, 1,1,1-	7.7E-02	0.9	NA	NC	NA	NA	1	4E-10	4E-10	NA	8E-10
Trichloroethene	3.6E-01	0.02	0.011	1	1E-10	1E-12	1	2E-09	9E-08	3E-12	2E-07
Vinyl chloride	2.8E-02	0.003	1.4	1.53	1E-11	2E-11	1	1E-10	4E-08	4E-11	9E-08
Total						4E-11			2E-07	8E-11	4E-07

NA - Not available
NC - Not calculated
ND - Not detected

Table A-120
Exposure and Risk Estimates Associated With Inhalation of Soil-Derived Particulates In Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker In streets
Ambient Air

Receptor:	Utility Worker	▼
Medium of Origin	Soil	▼
Exposure Medium:	Ambient Air	▼
Exposure Area:	Trench	▼
Depth:	0-6 feet	▼
Duration:	Subchronic	▼

Parameter	Definition	Units	Value	Comment
IRair	Outdoor Air Inhalation Rate - Particulates	m3/hr	4	
IRair TWA	Outdoor Air TWA Inhalation Rate - Particulates	m3-y/h-kg	0	
PEF	Outdoor Air PM10 - Particulates	ug/m3	60	
ET	Outdoor Air Exposure Time - Particulates	hr/d	8	
EF	Outdoor Air Exposure Frequency - Particulates	d/y	1	
EP	Outdoor Air Exposure Period - Cancer - Particulates	y	5	
EP	Outdoor Air Exposure Period - Non-Cancer - Particulates	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Particulates	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Particulates	d	1825	
BW	Body Weight	kg	58	
C	Conversion Factor	ug/mg	1000	

$$C_{air} = C_{soil} \times PM_{10}$$
$$ADD_{inh-gi} = \frac{C_{air} \times 1.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADD_{inh} = \frac{C_{air} \times 0.5 \times IR_{air} \times RAF_i \times ET \times EF \times EP \times C}{AP \times BW}$$
$$ADE_{inh} = \frac{ADD_{inh} \times 70kg}{20m^3 / d}$$
$$HI = \frac{ADD_{inh-gi}}{RfD} + \frac{ADE_{inh}}{RfC}$$
$$Risk = (ADD_{inh-gi} \times CSF) + (ADE_{inh} \times URF \times C)$$

Compound	EPC Soil (mg/kg)	EPC Fugitive Dust (mg/m3)	RIC (mg/m3)	URF 1/(ug/m3)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	RAFc	ADD-inhc mg/kg-d	ADE-c mg/m3	Riskinh	ADD-ingc	Risking	RAFi	ADD-inhc mg/kg-d	ADE-nc mg/m3	Hlinh	ADD-ingnc	Hling	Risk (Particulates in Air) YC-OC-A	HI (Particulates in Air) YC
Carbon tetrachloride	2.8E-02	1.7E-09	0.43	0.0000015	0.007	0.13	1	8E-14	3E-13	4E-15	2E-13	3E-14	1	1E-12	4E-12	9E-12	3E-12	5E-10	4E-14	5E-10
Chloroethane	5.6E-02	3.3E-09	10	NA	0.4	NA	NC	NA	NA	NA	NA	NA	1	2E-12	8E-12	8E-13	7E-12	2E-11	NA	2E-11
Chloroform	2.8E-02	1.7E-09	0.66	0.000023	0.01	NA	1	8E-14	3E-13	7E-15	NA	NA	1	1E-12	4E-12	6E-12	3E-12	3E-10	7E-15	3E-10
Dichloroethane, 1,1-	1.3E-01	7.8E-09	5	NA	1	NA	NC	NA	NA	NA	NA	NA	1	5E-12	2E-11	4E-12	2E-11	2E-11	NA	2E-11
Dichloroethane, cis-1,2-	2.8E-02	1.7E-09	0.035	NA	0.1	NA	NC	NA	NA	NA	NA	NA	1	1E-12	4E-12	1E-10	3E-12	3E-11	NA	1E-10
Dichloroethane, 1,1-	2.8E-02	1.7E-09	0.2	NA	0.05	NA	1	NA	NA	NA	NA	NA	1	1E-12	4E-12	2E-11	3E-12	7E-11	NA	9E-11
Tetrachloroethene	9.9E-01	5.9E-08	4.6	0.000001	0.1	0.051	1	3E-12	1E-11	1E-13	9E-12	4E-13	1	4E-11	1E-10	3E-11	1E-10	1E-09	5E-13	1E-09
Trans-1,2-Dichloroethene	2.8E-02	1.7E-09	0.7	NA	0.2	NA	NC	NA	NA	NA	NA	NA	1	1E-12	4E-12	6E-12	3E-12	2E-11	NA	2E-11
Trichloroethane, 1,1,1-	7.7E-02	4.6E-09	5.2	NA	0.9	NA	NC	NA	NA	NA	NA	NA	1	3E-12	1E-11	2E-12	9E-12	1E-11	NA	1E-11
Trichloroethene	3.6E-01	2.1E-08	0.18	0.0000017	0.02	0.011	1	1E-12	4E-12	6E-15	3E-12	3E-14	1	1E-11	5E-11	3E-10	4E-11	2E-09	4E-14	2E-09
Vinyl chloride	2.8E-02	1.7E-09	0.1	0.0000088	0.003	1.4	1	8E-14	3E-13	2E-15	2E-13	3E-13	1	1E-12	4E-12	4E-11	3E-12	1E-09	3E-13	1E-09
Total										1E-13		8E-13				5E-10		6E-09	1E-12	6E-09

NA - Not available
NC - Not calculated
ND - Not detected

Table A-121
Exposure and Risk Estimates Associated With Groundwater Contact
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Groundwater

Receptor:	Utility Worker
Medium:	Groundwater
Exposure Area:	Trench
Depth:	0-6 feet
Duration:	Subchronic

Parameter	Definition	Units	Value	Comment
IR _{gw}	Groundwater Ingestion Rate	L/d	0.01	
SA	Groundwater Dermal Contact Skin Exposed	cm ²	817	
EF	Groundwater Exposure Frequency	d/y	1	
EP	Groundwater Exposure Period - Cancer	y	5	
ATC	Groundwater Exposure Period - Non-Cancer	y	5	
ATn	Groundwater Averaging Time - Cancer	d	25550	
ET	Groundwater Averaging Time - Non-Cancer	d	1825	
BW	Groundwater Dermal Contact Exposure Time	hr/d	2	
CF	Body Weight	kg	58	
	Conversion Factor	L/cm ³	0.001	

$$ADD_{ing} = \frac{C_{gw} \times IR_{gw} \times RAF_{gw} \times EF \times EP}{AP \times BW}$$

$$ADD_{der} = \frac{C_{gw} \times CF \times SA \times K_p \times ET \times RAF_{dw} \times EF \times EP}{AP \times BW}$$

$$HI_{ing} = \frac{ADD_{ing}}{RfD}$$

$$HI_{der} = \frac{ADD_{der}}{RfD}$$

$$HI = HI_{ing} + HI_{der}$$

$$Risk = ADD_{ing} \times CSF$$

$$Risk = ADD_{der} \times CSF$$

$$Risk = Risk_{ing} + Risk_{der}$$

Compound	EPC Groundwater (mg/L)	RfD (mg/kg-d)	CSF 1/(mg/kg-d)	Incidental Ingestion RAFIwc mg/kg-d	ADDing-c mg/kg-d	Risking	RAFIwcnc	ADDing-nc mg/kg-d	Hling	Dermal Contact Kp (cm/hr)	RAFIwc	ADDder-c mg/kg-d	Riskder	RAFIwcnc	ADDder-nc mg/kg-d	Hlder	Total Risk(GW)	HI(GW)
Carbon tetrachloride	5.0E-04	0.007	0.13	1	2E-11	2E-12	1	2E-10	3E-08	1.6E-02	1	4E-11	6E-12	1	6E-10	9E-08	8E-12	1E-07
Chloroethane	1.0E-03	0.4	NA	NC	NA	NA	1	5E-10	1E-09	6.1E-03	NC	NA	NA	1	5E-10	1E-09	NA	2E-09
Chloroform	1.3E-02	0.01	NA	NC	NA	NA	1	6E-09	6E-07	6.8E-03	NC	NA	NA	1	7E-09	7E-07	NA	1E-06
Dichloroethane, 1,1-	4.9E-02	1	NA	NC	NA	NA	1.3	3E-08	3E-08	6.7E-03	NC	NA	NA	1	3E-08	3E-08	NA	6E-08
Dichloroethane, cis-1,2-	6.6E-02	0.1	NA	NC	NA	NA	1	3E-08	3E-07	6.6E-03	NC	NA	NA	1	3E-08	3E-07	NA	6E-07
Dichloroethane, 1,1-	2.9E-02	0.05	NA	NC	NA	NA	1	1E-08	3E-07	4.3E-03	NC	NA	NA	1	1E-08	2E-07	NA	5E-07
Tetrachloroethene	1.2E+01	0.1	0.051	1	4E-07	2E-08	1	6E-06	6E-05	3.3E-02	1	2E-06	1E-07	1	3E-05	3E-04	1E-07	4E-04
Trans-1,2-Dichloroethene	1.3E-02	0.2	NA	NC	NA	NA	1	6E-09	3E-08	1.1E-02	NC	NA	NA	1	1E-08	5E-08	NA	8E-08
Trichloroethane, 1,1,1-	9.2E-02	0.9	NA	NC	NA	NA	1	4E-08	5E-08	1.3E-02	NC	NA	NA	1	9E-08	1E-07	NA	1E-07
Trichloroethene	1.4E-01	0.02	0.011	1	5E-09	5E-11	1	7E-08	3E-06	1.2E-02	1	9E-09	1E-10	1	1E-07	6E-06	2E-10	1E-05
Vinyl chloride	1.3E-02	0.003	1.4	1.53	7E-10	9E-10	1	6E-09	2E-06	8.2E-03	1	6E-10	8E-10	1	8E-09	3E-06	2E-09	5E-06
Total						2E-08			7E-05				1E-07			3E-04	1E-07	4E-04

NA - Not available
NC - Not calculated
ND - Not detected
Assumes gw is at bottom of trench (~6')

Table A-122
Volatilization Factors
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets

Compound	Henry's Law Constant at Avg GW Temp (conc/conc) H ¹ _{TS}	Defl Vadose Zone (Layer A + Layer B)	Defl Total (Layer A + Layer B + Layer C)	Deflcrack (Layer A)	Exponent of Peclet Number	Organic Carbon- Water Partition Coefficient K _{oc}	Volatilization from Subsurface Soil to Excavation Air VF (mg/m3) / (mg/kg)	Volatilization from Subsurface Soil to Trench Air VF (mg/m3) / (mg/kg)	Volatilization from Soil Gas to Excavation Air Alpha (mg/m3 excav) / (mg/m3 SG)	Volatilization from Soil Gas to Trench Air Alpha (mg/m3 trench) / (mg/m3 SG)	Volatilization from Groundwater to Excavation Air VF (mg/m3) / (mg/L)	Volatilization from Groundwater to Trench Air VF (mg/m3) / (mg/L)
Carbon tetrachloride	5.88E-01	1.54E-02	7.49E-03	1.54E-02	1.28E+104	1.5E+02	1.53E-03	5.88E-02	-1.69E-06	3.51E-04	-4.84E-04	1.00E-01
Chloroethane	4.77E-01	5.35E-02	2.60E-02	5.35E-02	9.20E+29	2.4E+01	5.80E-03	2.23E-01	-5.88E-06	1.22E-03	-1.36E-03	2.82E-01
Chloroform	8.04E-02	2.05E-02	1.00E-02	2.05E-02	1.20E+78	5.3E+01	1.11E-03	4.28E-02	-2.26E-06	4.67E-04	-8.84E-05	1.83E-02
Dichloroethane, 1,1-	1.24E-01	1.46E-02	7.13E-03	1.46E-02	2.74E+109	5.3E+01	1.15E-03	4.43E-02	-1.61E-06	3.33E-04	-9.75E-05	2.02E-02
Dichloroethene, cis-1,2-	8.79E-02	1.45E-02	7.08E-03	1.45E-02	2.13E+110	3.6E+01	1.17E-03	4.51E-02	-1.60E-06	3.31E-04	-6.85E-05	1.42E-02
Dichloroethene, 1,1-	6.34E-01	1.78E-02	8.64E-03	1.78E-02	1.68E+90	6.5E+01	2.51E-03	9.62E-02	-1.95E-06	4.04E-04	-6.03E-04	1.25E-01
Tetrachloroethene	3.24E-01	1.42E-02	6.91E-03	1.42E-02	6.04E+112	2.7E+02	8.42E-04	3.23E-02	-1.56E-06	3.24E-04	-2.47E-04	5.11E-02
Trans-1,2-Dichloroethene	2.13E-01	1.40E-02	6.79E-03	1.40E-02	7.16E+114	3.8E+01	1.71E-03	6.55E-02	-1.53E-06	3.18E-04	-1.59E-04	3.30E-02
Trichloroethane, 1,1,1-	3.66E-01	1.54E-02	7.49E-03	1.54E-02	1.28E+104	1.4E+02	1.29E-03	4.95E-02	-1.69E-06	3.51E-04	-3.01E-04	6.24E-02
Trichloroethene	1.97E-01	1.56E-02	7.59E-03	1.56E-02	6.13E+102	9.4E+01	1.14E-03	4.38E-02	-1.71E-06	3.55E-04	-1.65E-04	3.41E-02
Vinyl chloride	7.65E-01	2.09E-02	1.02E-02	2.09E-02	4.04E+76	1.9E+01	4.71E-03	1.81E-01	-2.30E-06	4.76E-04	-8.56E-04	1.77E-01

Table A-123
Site-specific Parameters for Volatilization Calculations
50 Tuttle Street, Somerville MA
UnFirst
Utility Worker in Streets

Symbol	(units)	Parameter	Value	Comment
L_{crack}	(cm)	Thickness of foundation	15	
f_{oc}	(g/g)	Fraction organic carbon in vadose zone soil	0.02	
L_f	(15 or 200 cm)	Depth below grade to bottom of enclosed space floor	15	
L_{wrt}	(cm)	Depth below grade to water table	188	Input either 15 or 200 Ft.
T_s	Kelvin	Average soil/ groundwater temperature	283	10 (°C)
L_1	(cm)	Source- building separation	173	
L_g	(cm)	Length of building	961	DEP Default
W_g	(cm)	Width of building	961	DEP Default
H_g	(cm)	Height of building	488	DEP Default
X_{crack}	(cm)	Floor- wall seam perimeter	3.84E+03	
ER	(1/hr)	Air exchange rate	0.45	DEP Default
$Q_{building}$	(cm³/s)	Bldg. ventilation rate	5.63E+04	
A_g	(cm²)	Area of enclosed space below grade	9.24E+05	
η	(unitless)	Crack- to-total area ratio	4.16E-04	
Z_{crack}	(cm)	Crack depth below grade	15	
μ_{TS}	(g/cm-s)	Vapor viscosity at ave. soil temperature	1.75E-04	
L_d	(cm)	Diffusion path length	173	
L_p	(cm)	Convection path length	15	
r_{crack}	(cm)	Crack radius	0.10	DEP Default
ΔP	g/cm-s2	Pressure differential between soil surface and enclosed space	40	DEP Default
Q_{soil}	(cm³/s)	Average vapor flow rate into bldg.	9.45E+01	
A_{crack}	(cm²)	Area of crack	384	
Rc	(cal/mol-K)	Gas constant	1.99	
R	(atm-m3/mol-K)	Universal gas constant	8.21E-05	
R2	(mmHg-cm3/mol-K)	Universal gas constant	6.24E+04	
W_{sa}	(cm)	Width of soil source to ambient air	1.52E+03	50 Ft.
t_{sa}	(s)	Averaging time for volatilization from soil to ambient air	4.42E+05	0.014 y
U	(cm/s)	Wind speed	225	
D	(cm)	Mixing height	183	6 Ft.
Z_s	(cm)	Depth to soil source	188	6.16 Ft.
Z_{so}	(cm)	Depth to soil gas source	188	6.16 Ft.
W_E	(cm)	Width of excavation	1524	50 Ft.
L_E	(cm)	Length of excavation	762	25 Ft.
H_E	(cm)	Height of excavation	457	15 Ft.
W_{Ec}	(cm)	Width of excavation that is contaminated	1524	50 Ft.
L_{Ec}	(cm)	Length of excavation that is contaminated	762	25 Ft.
H_{Ec}	(cm)	Height of excavation that is contaminated	457	15 Ft.
WT	(cm)	Width of trench	457	15 Ft.
LT	(cm)	Length of trench	122	4 Ft.
HT	(cm)	Height of trench	183	6 Ft.
WTC	(cm)	Width of trench that is contaminated	457	15 Ft.
LTC	(cm)	Length of trench that is contaminated	122	4 Ft.
HTC	(cm)	Height of trench that is contaminated	183	6 Ft.
t_{SE}	(s)	Averaging time for volatilization from soil to excavation	1.58E+07	0.5 y
t_{ST}	(s)	Averaging time for volatilization from soil to trench	4.42E+05	0.014 y
F_E	(unitless)	Fraction of wind speed that occurs in excavation	0.5	
F_1	(unitless)	Fraction of wind speed that occurs in trench	0.1	
d	(cm)	Lower depth of surface soil source	462	15.16 Ft.
			Vadose Zone Layer A	Vadose Zone Layer B
P_o	(g/cm³)	Vadose zone soil dry bulk density	1.5	1.5
n	(unitless)	Vadose zone soil total porosity	0.43	0.43
θ_w	(cm³/cm³)	Vadose zone soil water-filled porosity	0.06	0.06
θ_a	(cm³/cm³)	Vadose zone soil air-filled porosity	0.37	0.37
h	(cm)	Thickness of soil layer	15	141
S_{oe}	(cm³/cm³)	Vadose zone effective total fluid saturation		1.86E-02
k_i	(cm²)	Vadose zone soil intrinsic permeability		9.92E-08
k_{vg}	(cm²)	Vadose zone soil relative air permeability		0.99
k_v	(cm²)	Vadose zone soil effective vapor permeability		9.79E-08

Select soil type in vadose zone and capillary zone:

Vadose zone adjacent to building

Capillary zone

Key:

Type in Site-specific values here
Calculated values
Constants
Default parameter values from DEP

Values Assume all sources are 1 inch below excavation depth

Table A-124
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Trench Air
Volatilization from Soil Gas

Receptor:	Utility Worker	▼
Medium of Origin:	Soil Gas	▼
Exposure Medium:	Trench Air	▼
Exposure Area:	Trench	▼
Depth:	0-6 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{soilgas} \times (VF \text{ or } \alpha_{pH})}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Soil Gas mg/m3	Alpha Volatilization from Soil Gas to Trench Air (mg/m3 trench) / (mg/m3 SG)	Source Dilution Factor	EPC Trench Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiC	ADE-nc mg/m3	HIinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	8.7E-01	3.51E-04	1	3.0E-04	0.43	0.000015	1	2E-08	3E-10	1	3E-07	6E-07	3E-10	6E-07
Chloroethane	3.6E-01	1.22E-03	1	4.4E-04	10	NA	NC	NA	NA	1	4E-07	4E-08	NA	4E-08
Chloroform	NA	4.67E-04	1	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	8.0E-01	3.33E-04	1	2.7E-04	5	NA	NC	NA	NA	1	2E-07	5E-08	NA	5E-08
Dichloroethane, cis-1,2-	5.5E-01	3.31E-04	1	1.8E-04	0.035	NA	NC	NA	NA	1	2E-07	5E-06	NA	5E-06
Dichloroethene, 1,1-	1.3E+00	4.04E-04	1	5.3E-04	0.2	NA	1	NA	NA	1	5E-07	2E-06	NA	2E-06
Tetrachloroethene	3.3E+02	3.24E-04	1	1.1E-01	4.6	0.00001	1	7E-06	7E-08	1	1E-04	2E-05	7E-08	2E-05
Trans-1,2-Dichloroethene	4.0E-04	3.18E-04	1	1.3E-07	0.7	NA	NC	NA	NA	1	1E-10	2E-10	NA	2E-10
Trichloroethane, 1,1,1-	3.7E+00	3.51E-04	1	1.3E-03	5.2	NA	NC	NA	NA	1	1E-06	2E-07	NA	2E-07
Trichloroethene	1.9E+00	3.55E-04	1	6.9E-04	0.18	0.0000017	1	4E-08	8E-11	1	6E-07	3E-06	8E-11	3E-06
Vinyl chloride	3.5E-01	4.76E-04	1	1.7E-04	0.1	0.0000088	1	1E-08	1E-10	1	2E-07	2E-06	1E-10	2E-06
Total									7E-08			3E-05	7E-08	3E-05

NA - Not available
NC - Not calculated
ND - Not detected

Table A-125
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Trench Air
Volatilization from Subsurface Soil

Receptor:	Utility Worker	▼
Medium of Origin:	Subsurface Soil	▼
Exposure Medium:	Trench Air	▼
Exposure Area:	Trench	▼
Depth:	0-6 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{soil} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Subsurface Soil mg/kg	VF Volatilization from Subsurface Soil to Trench Air (mg/m3) / (mg/kg)	Source Dilution Factor	EPC Trench Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	2.8E-02	5.88E-02	1	1.6E-03	0.43	0.000015	1	1E-07	2E-09	1	1E-06	3E-06	2E-09	3E-06
Chloroethane	5.6E-02	2.23E-01	1	1.2E-02	10	NA	NC	NA	NA	1	1E-05	1E-06	NA	1E-06
Chloroform	2.8E-02	4.28E-02	1	1.2E-03	0.66	0.000023	1	8E-08	2E-09	1	1E-06	2E-06	2E-09	2E-06
Dichloroethane, 1,1-	1.3E-01	4.43E-02	1	5.8E-03	5	NA	NC	NA	NA	1	5E-06	1E-06	NA	1E-06
Dichloroethene, cis-1,2-	2.8E-02	4.51E-02	1	1.3E-03	0.035	NA	NC	NA	NA	1	1E-06	3E-05	NA	3E-05
Dichloroethene, 1,1-	2.8E-02	9.62E-02	1	2.7E-03	0.2	NA	1	NA	NA	1	2E-06	1E-05	NA	1E-05
Tetrachloroethene	9.9E-01	3.23E-02	1	3.2E-02	4.6	0.00001	1	2E-06	2E-08	1	3E-05	6E-06	2E-08	6E-06
Trans-1,2-Dichloroethene	2.8E-02	6.55E-02	1	1.8E-03	0.7	NA	NC	NA	NA	1	2E-06	2E-06	NA	2E-06
Trichloroethane, 1,1,1-	7.7E-02	4.95E-02	1	3.8E-03	5.2	NA	NC	NA	NA	1	3E-06	7E-07	NA	7E-07
Trichloroethene	3.6E-01	4.38E-02	1	1.6E-02	0.18	0.000017	1	1E-06	2E-09	1	1E-05	8E-05	2E-09	8E-05
Vinyl chloride	2.8E-02	1.81E-01	1	5.0E-03	0.1	0.000088	1	3E-07	3E-09	1	5E-06	5E-05	3E-09	5E-05
Total									3E-08			2E-04	3E-08	2E-04

Table A-126

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Trench Air
Volatilization from Groundwater

Receptor:	Utility Worker	▼
Medium of Origin:	Groundwater	▼
Exposure Medium:	Trench Air	▼
Exposure Area:	Trench	▼
Depth:	0-15 feet	▼
Duration:	Subchronic	▼

$$C_{air} = \frac{C_{soil} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC Groundwater (mg/L)	VF Volatilization from Groundwater to Trench Air (mg/m3) / (mg/L)	Source Dilution Factor	EPC Trench Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	5.0E-04	1.00E-01	1	5.0E-05	0.43	0.000015	1	3E-09	5E-11	1	5E-08	1E-07	5E-11	1E-07
Chloroethane	1.0E-03	2.82E-01	1	2.8E-04	10	NA	NC	NA	NA	1	3E-07	3E-08	NA	3E-08
Chloroform	1.3E-02	1.83E-02	1	2.3E-04	0.66	0.000023	1	2E-08	4E-10	1	2E-07	3E-07	4E-10	3E-07
Dichloroethane, 1,1-	4.9E-02	2.02E-02	1	1.0E-03	5	NA	NC	NA	NA	1	9E-07	2E-07	NA	2E-07
Dichloroethane, cis-1,2-	6.6E-02	1.42E-02	1	9.3E-04	0.035	NA	NC	NA	NA	1	9E-07	2E-05	NA	2E-05
Dichloroethane, 1,1-	2.9E-02	1.25E-01	1	3.7E-03	0.2	NA	1	NA	NA	1	3E-06	2E-05	NA	2E-05
Tetrachloroethene	1.2E+01	5.11E-02	1	6.4E-01	4.6	0.00001	1	4E-05	4E-07	1	6E-04	1E-04	4E-07	1E-04
Trans-1,2-Dichloroethene	1.3E-02	3.30E-02	1	4.2E-04	0.7	NA	NC	NA	NA	1	4E-07	5E-07	NA	5E-07
Trichloroethane, 1,1,1-	9.2E-02	6.24E-02	1	5.7E-03	5.2	NA	NC	NA	NA	1	5E-06	1E-06	NA	1E-06
Trichloroethene	1.4E-01	3.41E-02	1	4.8E-03	0.18	0.0000017	1	3E-07	5E-10	1	4E-06	2E-05	5E-10	2E-05
Vinyl chloride	1.3E-02	1.77E-01	1	2.3E-03	0.1	0.0000088	1	1E-07	1E-09	1	2E-06	2E-05	1E-09	2E-05
Total									4E-07			2E-04	4E-07	2E-04

NA - Not available
NC - Not calculated
ND - Not detected

Table A-127
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Utility Worker in streets
Trench Air

Receptor:	Utility Worker	▼
Medium of Origin:		▼
Exposure Medium:	Trench Air	▼
Exposure Area:	Trench	▼
Depth:	0-6 feet	▼
Duration:	Subchronic	▼

All 3 media

$$C_{air} = \frac{C_{source} \times (VF \text{ or } \alpha)}{SDF}$$

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP}{24 \text{ hr} / d \times 365 \text{ d} / y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C$$

Parameter	Definition	Units	Value	Comment
ET	Outdoor Air Exposure Time - Volatiles	hr/d	8	
EF	Outdoor Air Exposure Frequency - Volatiles	d/y	1	
EP	Outdoor Air Exposure Period - Non-Cancer - Volatiles	y	5	
EP	Outdoor Air Exposure Period - Cancer - Volatiles	y	5	
ATc	Outdoor Air Averaging Time - Cancer - Volatiles	d	25550	
ATn	Outdoor Air Averaging Time - Non-Cancer - Volatiles	d	1825	
C	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiC	ADE-nc mg/m3	HIinh	Risk (Trench Air)	HI (Trench Air)
Carbon tetrachloride	6.6E-04	0.43	0.000015	1	4E-08	6E-10	1	6E-07	1E-06	6E-10	1E-06
Chloroethane	4.4E-03	10	NA	NC	NA	NA	1	4E-06	4E-07	NA	4E-07
Chloroform	7.1E-04	0.66	0.000023	1	5E-08	1E-09	1	6E-07	1E-06	1E-09	1E-06
Dichloroethane, 1,1-	NA	5	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, cis-1,2-	NA	0.035	NA	NC	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1,1-	NA	0.2	NA	1	NA	NA	1	NA	NA	NA	NA
Tetrachloroethene	2.6E-01	4.6	0.00001	1	2E-05	2E-07	1	2E-04	5E-05	2E-07	5E-05
Trans-1,2-Dichloroethene	7.5E-04	0.7	NA	NC	NA	NA	1	7E-07	1E-06	NA	1E-06
Trichloroethane, 1,1,1-	3.6E-03	5.2	NA	NC	NA	NA	1	3E-06	6E-07	NA	6E-07
Trichloroethene	7.1E-03	0.18	0.0000017	1	5E-07	8E-10	1	6E-06	4E-05	8E-10	4E-05
Vinyl chloride	2.5E-03	0.1	0.0000088	1	2E-07	1E-09	1	2E-06	2E-05	1E-09	2E-05
Total						2E-07			1E-04	2E-07	1E-04

NA - Not available
NC - Not calculated
ND - Not detected
Assumes groundwater is directly beneath the excavation

Table A-128
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
60 Tufts Street Unit 4

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	60 Tufts Street Unit 4	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.8E-03	4.6	0.00001	1	8E-04	8E-06	1	2E-03	4E-04	8E-06	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	8.6E-04	0.18	0.000017	1	4E-04	6E-07	1	9E-04	5E-03	6E-07	5E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						9E-06			3E-02	9E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-129
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
9 Tufts Street (left unit)

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	9 Tufts Street (left unit)	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.7E-03	4.6	0.00001	1	7E-04	7E-06	1	2E-03	4E-04	7E-06	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						9E-06			3E-02	9E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-130
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
9 Tufts Street (right Unit)

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	9 Tufts Street (right Unit)	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		4.1E-03	4.6	0.00001	1	2E-03	2E-05	1	4E-03	9E-04	2E-05	9E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene		5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride		2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							2E-05			3E-02	2E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-131
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
11-13 Tufts Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	11-13 Tufts Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.4E-03	4.6	0.00001	1	6E-04	6E-06	1	1E-03	3E-04	6E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.7E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	1.7E-06	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						7E-06			3E-02	7E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-132
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
17 Tufts Street

Receptor:

Resident

Medium of Origin:

Indoor Air

Exposure Medium:

Indoor Air

Exposure Area:

17 Tufts Street

Depth:

Duration:

Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFiC	ADE-c mg/m3	Riskinh	RAFiCinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	3.5E-03	4.6	0.00001	1	2E-03	1E-05	1	4E-03	8E-04	1E-05	8E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	1.4E-03	0.18	0.0000017	1	6E-04	1E-06	1	1E-03	8E-03	1E-06	8E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						2E-05			3E-02	2E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-133
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
19 Tufts Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	19 Tufts Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	4.1E-03	4.6	0.00001	1	2E-03	2E-05	1	4E-03	9E-04	2E-05	9E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	6.4E-03	5.2	NA	NC	NA	NA	1	6E-03	1E-03	NA	1E-03
Trichloroethene	1.7E-03	0.18	0.000017	1	7E-04	1E-06	1	2E-03	9E-03	1E-06	9E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						2E-05			3E-02	2E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-134
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
23 Tufts Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	23 Tufts Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CFI}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC		RfC (mg/m3)	URF 1/(ug/m3)	Risk		
	Indoor Air (mg/m3)	ADE-c mg/m3			RAFic	ADE-c mg/m3	HI (Indoor Air)
Carbon tetrachloride	NA	NA	0.43	0.000015	1	NA	NA
Chloroethane	NA	NA	10	NA	NC	NA	NA
Chloroform	NA	NA	0.66	0.000023	1	NA	NA
Dichloroethane, 1,1-	4.1E-04	NA	0.5	NA	1	NA	8E-04
Dichloroethane, cis-1,2-	4.0E-04	NA	0.035	NA	1	4E-04	1E-02
Dichloroethane, 1,1-	4.0E-04	NA	0.2	NA	1	4E-04	2E-03
Tetrachloroethene	8.4E-04	4E-04	4.6	0.00001	1	4E-04	2E-04
Trans-1,2-Dichloroethene	4.0E-04	NA	0.07	NA	NC	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	NA	5.2	NA	NC	NA	1E-04
Trichloroethene	5.5E-04	2E-04	0.18	1.7E-06	1	6E-04	3E-03
Vinyl chloride	2.6E-04	1E-04	0.1	8.8E-06	1	3E-04	3E-03
Total						5E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-135
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
25 Tufts Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	25 Tufts Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	2.6E-03	4.6	0.00001	1	1E-03	1E-05	1	3E-03	6E-04	1E-05	6E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	1.7E-06	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						1E-05			3E-02	1E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-136
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
27 Tufts Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	27 Tufts Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Exposure Period - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	9.3E-04	4.6	0.00001	1	4E-04	4E-06	1	9E-04	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	1.7E-06	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						5E-06			3E-02	5E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-137
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
49 Tufts Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	49 Tufts Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.0E-03	4.6	0.00001	1	4E-04	4E-06	1	1E-03	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.4E-04	5.2	NA	NC	NA	NA	1	5E-04	1E-04	NA	1E-04
Trichloroethene	6.0E-04	0.18	0.0000017	1	3E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						6E-06			3E-02	6E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-138
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
162-164 Glen Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	162-164 Glen Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAFE_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFc	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.6E-03	4.6	0.00001	1	7E-04	7E-06	1	2E-03	3E-04	7E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						8E-06			3E-02	8E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-139
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
6-8 Morton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	6-8 Morton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.5E-03	4.6	0.00001	1	6E-04	6E-06	1	2E-03	3E-04	6E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						8E-06			3E-02	8E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-140
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
10 Morton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	10 Morton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	7.0E-04	4.6	0.00001	1	3E-04	3E-06	1	7E-04	2E-04	3E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	1.6E-03	0.18	1.7E-06	1	7E-04	1E-06	1	2E-03	9E-03	1E-06	9E-03
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						5E-06			3E-02	5E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-141
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
12 Morton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	12 Morton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		7.7E-04	4.6	0.00001	1	3E-04	3E-06	1	8E-04	2E-04	3E-06	2E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene		5.5E-04	0.18	1.7E-06	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride		2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							5E-06			3E-02	5E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-142
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
18 Morton Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	18 Morton Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Exposure Period - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC		RfC (mg/m3)	URF 1/(ug/m3)	Risk			HI (Indoor Air)
	Indoor Air (mg/m3)	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	(Indoor Air)	
Carbon tetrachloride	NA	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.3E-03	6E-04	6E-06	1	1E-03	3E-04	6E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	7.4E-04	3E-04	5E-07	1	7E-04	4E-03	5E-07	4E-03
Vinyl chloride	2.6E-04	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total			7E-06			3E-02	7E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-143
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
19-19A Morton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	19-19A Morton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

EPC		RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinC	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Compound	Indoor Air (mg/m3)										
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.8E-03	4.6	0.00001	1	8E-04	8E-06	1	2E-03	4E-04	8E-06	4E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	1.5E-03	0.18	1.7E-06	1	6E-04	1E-06	1	2E-03	8E-03	1E-06	8E-03
Vinyl chloride	2.6E-04	0.1	8.8E-06	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						1E-05			3E-02	1E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-144
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
12-14 Knowlton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	12-14 Knowlton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.0E-03	4.6	0.00001	.1	4E-04	4E-06	1	1E-03	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						6E-06			3E-02	6E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-145
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
17 Knowlton Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	17 Knowlton Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		9.5E-04	4.6	0.00001	1	4E-04	4E-06	1	1E-03	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene		5.5E-04	0.18	0.000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride		2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							5E-06			3E-02	5E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-146
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
23 Knowlton Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	23 Knowlton Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	Indoor Air (mg/m3)	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride		NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane		NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform		NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-		4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-		4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-		4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene		1.2E-03	4.6	0.00001	1	5E-04	5E-06	1	1E-03	3E-04	5E-06	3E-04
Trans-1,2-Dichloroethene		4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-		6.0E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene		6.4E-04	0.18	0.0000017	1	3E-04	5E-07	1	6E-04	4E-03	5E-07	4E-03
Vinyl chloride		2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total							7E-06			3E-02	7E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-147

Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
95 Franklin Street

Receptor:	Resident	▼
Medium of Origin:	Indoor Air	▼
Exposure Medium:	Indoor Air	▼
Exposure Area:	95 Franklin Street	▼
Depth:		▼
Duration:	Chronic	▼

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	5	EP/EM modification in progress
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinh	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.7E-02	4.6	0.00001	1	1E-03	1E-05	1	2E-02	4E-03	1E-05	4E-03
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	6.1E-04	0.18	0.0000017	1	4E-05	7E-08	1	6E-04	3E-03	7E-08	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	2E-05	2E-07	1	3E-04	3E-03	2E-07	3E-03
Total						1E-05			3E-02	1E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-148
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
97 Franklin Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	97 Franklin Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC		RfC (mg/m3)	URF 1/(ug/m3)	ADE-c mg/m3					Riskinh	RAFinh	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)		HI (Indoor Air)
	Indoor Air (mg/m3)				RAFc	ADE-c mg/m3										
Carbon tetrachloride	NA		0.43	0.000015	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA		10	NA	NC	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA		0.66	0.000023	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04		0.5	NA	NC	NA	NA	NA	1	4E-04	8E-04	4E-04	8E-04	NA	8E-04	8E-04
Dichloroethene, cis-1,2-	4.0E-04		0.035	NA	NC	NA	NA	NA	1	4E-04	1E-02	4E-04	1E-02	NA	1E-02	1E-02
Dichloroethene, 1,1-	4.0E-04		0.2	NA	1	NA	NA	NA	1	4E-04	2E-03	4E-04	2E-03	NA	2E-03	2E-03
Tetrachloroethene	9.2E-04		4.6	0.00001	1	4E-04	4E-06	4E-06	1	9E-04	2E-04	9E-04	2E-04	4E-06	2E-04	2E-04
Trans-1,2-Dichloroethene	4.0E-04		0.07	NA	NC	NA	NA	NA	1	4E-04	6E-03	4E-04	6E-03	NA	6E-03	6E-03
Trichloroethane, 1,1,1-	5.5E-04		5.2	NA	NC	NA	NA	NA	1	6E-04	1E-04	6E-04	1E-04	NA	1E-04	1E-04
Trichloroethene	5.8E-04		0.18	0.0000017	1	2E-04	4E-07	4E-07	1	6E-04	3E-03	6E-04	3E-03	4E-07	3E-03	3E-03
Vinyl chloride	2.6E-04		0.1	0.0000088	1	1E-04	1E-06	1E-06	1	3E-04	3E-03	3E-04	3E-03	1E-06	3E-03	3E-03
Total							5E-06	5E-06			3E-02		3E-02	5E-06		3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-149
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
99 Franklin Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	99 Franklin Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	HIinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.5E-03	4.6	0.00001	1	6E-04	6E-06	1	2E-03	3E-04	6E-06	3E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						8E-06			3E-02	8E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-150
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
105-107 Washington Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	105-107 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$
$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$
$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
	Indoor Air (mg/m3)										
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	3.0E-03	4.6	0.00001	1	1E-03	1E-05	1	3E-03	7E-04	1E-05	7E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						1E-05			3E-02	1E-05	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-151
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
111 Washington Street

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	111 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC	RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
Tetrachloroethene	1.0E-03	4.6	0.00001	1	4E-04	4E-06	1	1E-03	2E-04	4E-06	2E-04
Trans-1,2-Dichloroethene	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
Trichloroethene	5.5E-04	0.18	0.000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
Total						6E-06			3E-02	6E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

Table A-152
Exposure and Risk Estimates Associated With Inhalation of Volatile Compounds in Air
50 Tufts Street, Somerville MA
UniFirst
Current/Future Resident at other streets
Indoor Air
4 Morton

Receptor:	Resident
Medium of Origin:	Indoor Air
Exposure Medium:	Indoor Air
Exposure Area:	111 Washington Street
Depth:	
Duration:	Chronic

$$ADE_{inh} = \frac{C_{air} \times RAF_i \times ET \times EF \times EP \times CF}{24hr/d \times 365d/y \times AT}$$

$$HI_{inh} = \frac{ADE_{inh}}{RfC}$$

$$Risk = ADE_{inh} \times URF \times C2$$

Parameter	Definition	Units	Value	Comment
ET	Indoor Air Exposure Time	h/d	24	
EF	Indoor Air Exposure Frequency	d/y	365	
EP	Indoor Air Exposure Period - Cancer	y	30	
EP	Indoor Air Exposure Period - Non-Cancer	y	7	
ATc	Indoor Air Averaging Time - Cancer	d	25550	
ATn	Indoor Air Averaging Time - Non-Cancer	d	2555	
C1	Conversion Factor	d/y	365	
C2	Conversion Factor	ug/mg	1000	

Compound	EPC		RfC (mg/m3)	URF 1/(ug/m3)	RAFic	ADE-c mg/m3	Riskinh	RAFinc	ADE-nc mg/m3	Hlinh	Risk (Indoor Air)	HI (Indoor Air)
	Indoor Air (mg/m3)											
Compound	Carbon tetrachloride	NA	0.43	0.000015	1	NA	NA	1	NA	NA	NA	NA
	Chloroethane	NA	10	NA	NC	NA	NA	1	NA	NA	NA	NA
	Chloroform	NA	0.66	0.000023	1	NA	NA	1	NA	NA	NA	NA
	Dichloroethane, 1,1-	4.1E-04	0.5	NA	NC	NA	NA	1	4E-04	8E-04	NA	8E-04
	Dichloroethene, cis-1,2-	4.0E-04	0.035	NA	NC	NA	NA	1	4E-04	1E-02	NA	1E-02
	Dichloroethene, 1,1-	4.0E-04	0.2	NA	1	NA	NA	1	4E-04	2E-03	NA	2E-03
	Tetrachloroethene	1.8E-03	4.6	0.00001	1	8E-04	8E-06	1	2E-03	4E-04	8E-06	4E-04
	Trans-1,2-Dichloroethane	4.0E-04	0.07	NA	NC	NA	NA	1	4E-04	6E-03	NA	6E-03
	Trichloroethane, 1,1,1-	5.5E-04	5.2	NA	NC	NA	NA	1	6E-04	1E-04	NA	1E-04
	Trichloroethene	5.5E-04	0.18	0.0000017	1	2E-04	4E-07	1	6E-04	3E-03	4E-07	3E-03
	Vinyl chloride	2.6E-04	0.1	0.0000088	1	1E-04	1E-06	1	3E-04	3E-03	1E-06	3E-03
	Total						9E-06			3E-02	9E-06	3E-02

NA - Not available
NC - Not calculated
ND - Not detected

ATTACHMENT B

DESCRIPTION OF AMBIENT AIR VOLATILIZATION MODEL (EXCAVATION/TRENCH)

Description of the Volatilization Model into Trench/Excavation

ASTM (1995) presented a series of simple models for calculating the equilibrium concentration of volatile compounds in ambient air above soil or groundwater sources. These equations were based on flux to the surface produced by assumed molecular diffusion of volatile compounds through porosities in soil into a “box” of air. Loading of the box is countered by wind movement through the box. Molecular diffusion occurs down a concentration gradient, and it is assumed in each of these models that the concentration of volatile compounds in the ambient air box is so low relative to the soil vapour concentration at the source as to be equivalent to zero.

ASTM provided basic equations for calculating “volatilization factors” (VF), which, when multiplied by a site-specific media concentration (groundwater or soil concentration) will produce an estimate of ambient air concentration. The VF algorithms are:

$$VF_{ss} = \frac{W \times C \times 2 \times B \left(\frac{D_{eff} \times H}{\sqrt{\pi \times (E_m + k_{oc} \times foc \times B + E_v \times H) \times t}} \right)}{U_{air} \times \delta_{air}}$$

Equation 1

$$VF_{samb} = \frac{H \times B}{(E_m + k_{oc} \times foc \times B + E_v \times H) \times (1 + (U_{air} \times \delta_{air} \times z / (D_{eff} \times W)))}$$

Equation 2

$$VF_{wamb} = \frac{H \times C}{1 + (U_{air} \times \delta_{air} \times z / (W \times D_{eff}))}$$

Equation 3

The volatilization factors VF_{ss} , VF_{samb} , and VF_{wamb} in Equations 1-3 are used to estimate ambient air concentrations from surface soil sources, soil sources beneath a clean cover of thickness z , and from groundwater at z depth below ground surface, respectively.

In order to estimate volatile concentrations in a trench, slight modifications of the VF terms described above are required. The most significant modification to the model for volatilization from soils at the surface of a trench or other excavation, was to account for the potential sources in the side walls. The basis assumption is that the hypothetical box of air mentioned above could now be described by the dimensions (or a portion of the dimensions) of the trench or excavation in which the receptors were assumed to be exposed (the dimensions of the subsurface space would also affect proximity to the source). Further, because the airspace is below ground surface, one would not expect wind clearance of air to be as efficient. Accordingly, a term producing a decrement in wind speed is added. The resulting equations are:

$$VF_{trench} = \frac{(W_c \times L_c + 2 \times L_c \times D_c + 2 \times W_c \times D_c) \times C \times 2 \times B \left(\frac{D_{eff} \times H}{\sqrt{\pi \times (E_m + k_{oc} \times f_{oc} \times B + E_v \times H) \times t}} \right)}{V_t \times A}$$

Equation 4

Where:

$$D_{eff} = \frac{D_a \times E_m^{3.33}}{(E_t^2)} + \frac{D_w \times E_m^{3.33}}{(H \times E_t^2)}$$

$$A = (U \times L \times D \times F_t) / V_t$$

W: Trench width in downwind direction (cm)

D: Depth of trench (cm)

L: Length of trench transverse to the wind (cm)

V_t: Volume of trench (cm³)

W_c: Length of contamination in width direction (cm)

D_c: Length of contamination in height direction (cm)

L_c: Length of contamination in length direction (cm)

C: Conversion factor (cm³-kg/m³-g)

D_{eff}: Effective molecular diffusion through soil (cm²/s)

H: Henry's Law Coefficient (cm³-water/cm³-air)

B: Soil bulk density (g/cm³)

E_m: Water-filled soil porosity (unitless)

E_v: Air-filled soil porosity (unitless)

E_t: Total soil porosity

K_{oc}: organic carbon-water sorption coefficient (cm³-water/g-carbon)

F_{oc}: Fraction organic carbon

t: averaging time for flux (s)

U: Mean annual wind speed (cm/s)

F_t: Fraction of mean annual wind speed that occurs in trench

A: air exchange rate (s⁻¹)

D_a: Molecular diffusion constant in air (cm²/s)

D_w: Molecular diffusion constant in water (cm²/s)

ATTACHMENT C

DATA CONSIDERED IN UPDATED REVISED SUPPLEMENTAL RISK CHARACTERIZATION

AND

2008 PHASE II CSA FIGURES REFERENCED IN THIS DOCUMENT

Attachment C 1a
Risk Characterization Data - Soil
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			50 Tufts Street				
Sample Name:			50TUFT-SOIL1	50TUFT-SOIL2	50TUFT-SOIL3	50TUFT-SOIL4	50TUFT-SOIL5
Sample Depth (ft):			0 to 2	0 to 2	0 to 2	0 to 2	0 to 2
Sample Date:			2/26/2008	2/26/2008	2/26/2008	2/26/2008	2/26/2008
Analyte	Method	Units					
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	SW 8260	mg/kg	< 0.091	< 0.092	< 0.099	< 0.099	< 0.096
Chloroethane			< 0.23	< 0.23	< 0.25	< 0.25	< 0.24
Chloroform			NT	NT	NT	NT	NT
1,1-Dichloroethane			< 0.091	< 0.092	< 0.099	< 0.099	< 0.096
1,1-Dichloroethylene			< 0.091	< 0.092	< 0.099	< 0.099	< 0.096
cis-1,2-Dichloroethylene			< 0.091	< 0.092	< 0.099	< 0.099	< 0.096
trans-1,2-Dichloroethylene			< 0.091	< 0.092	< 0.099	< 0.099	< 0.096
Tetrachloroethylene (PCE)			10.4	0.0734 J	0.326	43.2	1.51
1,1,1-Trichloroethane (TCA)			0.716	< 0.092	< 0.099	< 0.099	< 0.096
Trichloroethylene (TCE)			0.123	< 0.092	< 0.099	0.0529 J	< 0.096
Vinyl chloride			< 0.091	< 0.092	< 0.099	< 0.099	< 0.096

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. mg/kg = milligrams per kilogram.
4. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1b
Risk Characterization Data - Soil
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			MW201	MW202
Sample Name:			MW201-GP3(11-13')	MW202-GP3 (13-15')
Sample Depth (ft):			11 to 13	13 to 15
Sample Date:			7/11/2007	7/10/2007
Analyte	Method	Units		
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg		
Carbon tetrachloride			< 0.095	
Chloroethane			< 0.24	
Chloroform			NT	
1,1-Dichloroethane			< 0.095	
1,1-Dichloroethylene			< 0.095	
cis-1,2-Dichloroethylene			< 0.095	
trans-1,2-Dichloroethylene			< 0.095	
Tetrachloroethylene (PCE)			< 0.095	
1,1,1-Trichloroethane (TCA)			0.178	
Trichloroethylene (TCE)			< 0.095	
Vinyl chloride			0.0344 J	
			< 0.095	

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1c
Risk Characterization Data - Soil
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			GEO-4	MW109		27 Tufts Street
Sample Name:			GEO-4	B109 (7-9')	B109 (13-15')	27TUFT-SOIL
Sample Depth (ft):			11 to 13	3 to 3	13 to 15	0 to 2
Sample Date:			8/12/2004	1/3/2007	1/5/2007	2/19/2008
Analyte	Method	Units				
Volatile Organic Compounds (VOCs)			SW 8260			
Carbon tetrachloride		mg/kg	< 0.0556	< 0.1	< 0.088	< 0.16
Chloroethane			< 0.111	< 0.26	< 0.22	< 0.4
Chloroform			< 0.0556	< 0.1	< 0.088	NT
1,1-Dichloroethane			< 0.0556	< 0.1	< 0.088	< 0.16
1,1-Dichloroethylene			< 0.0556	< 0.1	< 0.088	< 0.16
cis-1,2-Dichloroethylene			< 0.0556	< 0.1	< 0.088	< 0.16
trans-1,2-Dichloroethylene			< 0.0556	< 0.1	< 0.088	< 0.16
Tetrachloroethylene (PCE)			0.111	0.324	< 0.088	< 0.16
1,1,1-Trichloroethane (TCA)			0.0795	< 0.1	< 0.088	< 0.16
Trichloroethylene (TCE)			< 0.0556	< 0.1	< 0.088	< 0.16
Vinyl chloride			< 0.0556	< 0.1	< 0.088	< 0.16

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. mg/kg = milligrams per kilogram.
4. NT = not tested.

Attachment C 1d
Risk Characterization Data - Soil
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW105	MW114		MW115	10 Alston Street
	Sample Name:		MW105S1	MW114	MW114	MW115	10ALST-SOIL
	Sample Depth (ft):		2 to 3	(2'-4') 2 to 4	(11'-13') 11 to 13	(2'-4') 2 to 4	0 to 2
	Sample Date:		4/28/2006	2/13/2007	2/15/2007	2/13/2007	2/19/2008
	Method	Units					
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg					
Carbon tetrachloride			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
Chloroethane			< 0.38	< 0.28	< 0.22	< 0.31	< 0.41
Chloroform			< 0.15	< 0.11	< 0.09	< 0.13	NT
1,1-Dichloroethane			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
1,1-Dichloroethylene			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
cis-1,2-Dichloroethylene			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
trans-1,2-Dichloroethylene			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
Tetrachloroethylene (PCE)			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
1,1,1-Trichloroethane (TCA)			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
Trichloroethylene (TCE)			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17
Vinyl chloride			< 0.15	< 0.11	< 0.09	< 0.13	< 0.17

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. mg/kg = milligrams per kilogram.
4. NT = not tested.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			150 Glen Street		MW101		MW102	
Analyte	Sample Name:		GARDEN-2 (2'-2.5') 0 to 2.5 3/30/2007	GARDEN-1 (2'-2.5') 0 to 2.5 3/30/2007	MW101S1 2 to 3 4/27/2006	MW101S4 13.5 to 15.5 5/1/2006	MW102S1 2 to 3 4/27/2006	MW102S5 12.5 to 14.6 5/1/2006
	Sample Depth (ft):							
	Sample Date:	Method	Units					
Volatile Organic Compounds (VOCs)			SW 8260	mg/kg				
Carbon tetrachloride			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083
Chloroethane			< 0.25	< 0.24	< 0.33	< 0.25	< 0.29	< 0.21
Chloroform			NT	NT	< 0.13	< 0.1	< 0.12	< 0.083
1,1-Dichloroethane			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083
1,1-Dichloroethylene			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083
cis-1,2-Dichloroethylene			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083
trans-1,2-Dichloroethylene			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083
Tetrachloroethylene (PCE)			< 0.099	< 0.098	0.989	0.0649 J	< 0.12	0.164
1,1,1-Trichloroethane (TCA)			< 0.099	< 0.098	0.0767 J	< 0.1	< 0.12	< 0.083
Trichloroethylene (TCE)			< 0.099	< 0.098	0.358	< 0.1	< 0.12	< 0.083
Vinyl chloride			< 0.099	< 0.098	< 0.13	< 0.1	< 0.12	< 0.083

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			MW103			MW106	
Sample Name:			MW103S1	MW103S2	MW103S6	B106 (12-14')	B106-VAC- GRAB
Sample Depth (ft):			2 to 3	6 to 8	14 to 16	12 to 14	3 to 3
Sample Date:			4/27/2006	5/1/2006	5/1/2006	1/5/2007	1/3/2007
Analyte	Method	Units					
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg					
Carbon tetrachloride			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
Chloroethane			< 0.3	< 0.23	< 0.21	< 0.22	< 0.29
Chloroform			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
1,1-Dichloroethane			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
1,1-Dichloroethylene			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
cis-1,2-Dichloroethylene			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
trans-1,2-Dichloroethylene			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
Tetrachloroethylene (PCE)			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
1,1,1-Trichloroethane (TCA)			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
Trichloroethylene (TCE)			< 0.12	< 0.091	0.722	< 0.087	< 0.11
Vinyl chloride			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11
			< 0.12	< 0.091	< 0.082	< 0.087	< 0.11

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			MW110				MW111		
Analyte	Method	Units	B110-VAC-GRAB 3 to 3 1/4/2007	B110 (7-9') 7 to 9 1/8/2007	B100 (FD) 7 to 9 1/8/2007	B110 (13-14') 13 to 14 1/8/2007	B111-VAC-GRAB 3 to 3 1/4/2007	B111 (7-9') 7 to 9 1/8/2007	B111 (13-15') 13 to 15 1/8/2007
	Sample Name:								
	Sample Depth (ft): Sample Date:								
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	SW 8260	mg/kg	< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
Chloroethane			< 0.25	< 0.29	< 0.27	< 0.23	< 0.22	< 0.26	< 0.19
Chloroform			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
1,1-Dichloroethane			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
1,1-Dichloroethylene			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
cis-1,2-Dichloroethylene			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
trans-1,2-Dichloroethylene			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
Tetrachloroethylene (PCE)			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	3.15
1,1,1-Trichloroethane (TCA)			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075
Trichloroethylene (TCE)			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	0.0469 J
Vinyl chloride			< 0.1	< 0.11	< 0.11	< 0.092	< 0.087	< 0.1	< 0.075

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:			MW112		MW112A		MW116	MW118D
	Sample Name:			B112-VAC-GRAB	B112	B112A	B112A	B116	B118D-S2
	Sample Depth (ft): Sample Date:			3 to 3 1/4/2007	6 to 7 1/8/2007	10 to 12 3/10/2007	0 to 3 3/10/2007	0 to 3 3/10/2007	10 to 12 6/25/2007
	Method	Units							
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg							
Carbon tetrachloride				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
Chloroethane				< 0.27	< 0.28	< 0.31	< 0.32	< 0.32	< 0.3
Chloroform				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
1,1-Dichloroethane				< 0.11	< 0.11	0.13 J	< 0.13	< 0.13	< 0.12
1,1-Dichloroethylene				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
cis-1,2-Dichloroethylene				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
trans-1,2-Dichloroethylene				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
Tetrachloroethylene (PCE)				0.11 F+	< 0.11	0.13 J	0.0471 J	< 0.13	0.233
1,1,1-Trichloroethane (TCA)				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
Trichloroethylene (TCE)				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12
Vinyl chloride				< 0.11	< 0.11	< 0.13	< 0.13	< 0.13	< 0.12

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW120D		SB121A	MW121D		
	Sample Name:		B-120-S3	B120-S7	MW-121A-Vac1	MW121D-VAC1	MW121D-VAC2	MW121D-S3
	Sample Depth (ft):		4 to 6	14 to 16	0 to 3	1 to 3	3 to 5	10 to 12
	Sample Date:		8/8/2007	8/8/2007	10/5/2007	10/5/2007	10/5/2007	10/6/2007
	Method	Units						
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg						
Carbon tetrachloride			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
Chloroethane			< 0.25	< 0.29	< 0.24	< 0.27	< 0.32	< 0.33
Chloroform			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
1,1-Dichloroethane			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
1,1-Dichloroethylene			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
cis-1,2-Dichloroethylene			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
trans-1,2-Dichloroethylene			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
Tetrachloroethylene (PCE)			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
1,1,1-Trichloroethane (TCA)			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
Trichloroethylene (TCE)			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13
Vinyl chloride			< 0.1	< 0.12	< 0.097	< 0.11	< 0.13	< 0.13

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW122		13 Morton Street	163 Glen Street	19 Knowlton Street	29 Knowlton Street
	Sample Name:		B122-S1	B122-S3	13MORT-SO	163GLEN-SOIL	19KNOW-SOIL	29KNOW-SOIL
	Sample Depth (ft):	Sample Date:	6 to 8 1/23/2008	10 to 12 1/24/2008	0 to 2 2/7/2008	0 to 2 2/19/2008	0 to 2 3/11/2008	0 to 2 2/21/2008
	Method	Units						
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg						
	Carbon tetrachloride	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	Chloroethane	< 0.27	< 0.27	< 0.36	< 0.31	< 0.33	< 0.3	
	Chloroform	< 0.11	< 0.11	< 0.14	NT	NT	NT	
	1,1-Dichloroethane	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	1,1-Dichloroethylene	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	cis-1,2-Dichloroethylene	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	trans-1,2-Dichloroethylene	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	Tetrachloroethylene (PCE)	0.0257 J	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
	1,1,1-Trichloroethane (TCA)	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12	
Trichloroethylene (TCE)	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12		
Vinyl chloride	< 0.11	< 0.11	< 0.14	< 0.12	< 0.13	< 0.12		

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		35-37 Knowlton Street	4 Morton Street	74 Franklin Street	82 Franklin Street	95R Franklin Street		
	Sample Name:		35-37KNOW-SOIL	4MORT-SO	74FRANK-SOIL	82FRANK-SOIL	95RBACK SOIL-1	95RBACK SOIL-5-7	95RFRONT SOIL-1
	Sample Depth (ft): Sample Date:		0 to 2 2/19/2008	0 to 2 2/7/2008	0 to 2 2/21/2008	0 to 2 3/6/2008	0 to 3 1/8/2008	5 to 7 1/8/2008	0 to 3 1/9/2008
	Method	Units							
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg							
Carbon tetrachloride			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
Chloroethane			< 0.37	< 0.26	< 0.31	< 0.32	< 0.41	< 0.46	< 0.33
Chloroform			NT	< 0.1	NT	NT	NT	NT	NT
1,1-Dichloroethane			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
1,1-Dichloroethylene			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
cis-1,2-Dichloroethylene			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
trans-1,2-Dichloroethylene			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
Tetrachloroethylene (PCE)			< 0.15	0.537	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
1,1,1-Trichloroethane (TCA)			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
Trichloroethylene (TCE)			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13
Vinyl chloride			< 0.15	< 0.1	< 0.13	< 0.13	< 0.16	< 0.18	< 0.13

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimate

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			95R Franklin Street (continued)							
Analyte	Sample Name:	Method	Units	95RFRONT SOIL-7-8	95RFRANK- EASTFILL	95RFRANK- EASTSILT	95FRANK- NORTH FILL	95FRANK- NORTH SILT	95FRANK- SOUTH FILL	95FRANK- SOUTH SILT
	Sample Depth (ft):			7 to 8	0 to 0.5	0.5 to 1	0 to 0.5	0.5 to 1	0 to 0.5	0.5 to 1
	Sample Date:			1/9/2008	12/14/2007	12/14/2007	12/11/2007	12/11/2007	12/11/2007	12/11/2007
Volatile Organic Compounds (VOCs)	Carbon tetrachloride	SW 8260	mg/kg	< 0.25	< 0.2	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17
	Chloroethane			< 0.63	< 0.51	< 0.49	< 0.47	< 0.42	< 0.65	< 0.41
	Chloroform			NT	< 0.2	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17
	1,1-Dichloroethane			< 0.25	0.43	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17
	1,1-Dichloroethylene			< 0.25	0.106 J	< 0.19	< 0.19	< 0.17	0.491	< 0.17
	cis-1,2-Dichloroethylene			< 0.25	0.0969 J	< 0.19	< 0.19	< 0.17	0.674	< 0.17
	trans-1,2-Dichloroethylene			< 0.25	< 0.2	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17
	Tetrachloroethylene (PCE)			< 0.25	46.2	3.34	1.14	< 0.17	58.9	0.0381 J
	1,1,1-Trichloroethane (TCA)			< 0.25	0.0476 J	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17
	Trichloroethylene (TCE)			< 0.25	2.16	0.319	0.268	< 0.17	6.17	< 0.17
	Vinyl chloride			< 0.25	< 0.2	< 0.19	< 0.19	< 0.17	< 0.26	< 0.17

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1e
Risk Characterization Data - Soil
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			95RSUBSOIL		
Sample Name:			95RFRANK- WESTSILT		
Sample Depth (ft): Sample Date:			0.5 to 1 12/14/2007		
Sample Date:			12/14/2007		
Analyte	Method	Units	95RFRANK- WESTFILL	95RFRANK- WESTSILT	95RSUBSOIL
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg	0 to 0.5 12/14/2007	0.5 to 1 12/14/2007	0 to 1 12/5/2007
Carbon tetrachloride			< 0.24	< 0.16	< 0.21
Chloroethane			< 0.6	< 0.39	< 0.53
Chloroform			< 0.24	< 0.16	< 0.21
1,1-Dichloroethane			< 0.24	< 0.16	0.107 J
1,1-Dichloroethylene			< 0.24	< 0.16	0.184 J
cis-1,2-Dichloroethylene			< 0.24	< 0.16	0.772
trans-1,2-Dichloroethylene			0.132 J	< 0.16	< 0.21
Tetrachloroethylene (PCE)			< 0.24	< 0.16	42.1
1,1,1-Trichloroethane (TCA)			5.64	< 0.16	0.0604 J
Trichloroethylene (TCE)			< 0.24	< 0.16	3.31
Vinyl chloride			0.66	< 0.16	< 0.21
			< 0.24	< 0.16	

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1f
Risk Characterization Data - Soil
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		GEO-4	MW102		MW103		MW105	MW106				
	Method	Units		Sample Name:		MW102S1	MW102S5		MW103S1	MW103S2	MW103S6	B106 (12-14') 12 to 14 1/5/2007	B106-VAC- GRAB 3 to 3 1/3/2007
				Sample Depth (ft):	Sample Date:								
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg											
Carbon tetrachloride			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
Chloroethane			< 0.111	< 0.29	< 0.21	< 0.3	< 0.23	< 0.21	< 0.38	< 0.22	< 0.29		
Chloroform			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
1,1-Dichloroethane			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
1,1-Dichloroethylene			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
cis-1,2-Dichloroethylene			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
trans-1,2-Dichloroethylene			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
Tetrachloroethylene (PCE)			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
1,1,1-Trichloroethane (TCA)			0.111	< 0.12	0.164	< 0.12	< 0.091	0.722	< 0.15	< 0.087	< 0.11		
Trichloroethylene (TCE)			0.0795	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		
Vinyl chloride			< 0.0556	< 0.12	< 0.083	< 0.12	< 0.091	< 0.082	< 0.15	< 0.087	< 0.11		

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. mg/kg = milligrams per kilogram.
4. NT = not tested.
5. FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1f

Risk Characterization Data - Soil
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW109			MW110				MW111	
	Sample Name:		B109-VAC-	B109	B109	B110-VAC-	B110	B100	B110	B111-VAC-	B111
	Sample Depth (ft): Sample Date:		GRAB 3 to 3 1/3/2007	(7-9') 7 to 9 1/5/2007	(13-15') 13 to 15 1/5/2007	GRAB 3 to 3 1/4/2007	(7-9') 7 to 9 1/8/2007	(FD) 7 to 9 1/8/2007	(13-14') 13 to 14 1/8/2007	GRAB 3 to 3 1/4/2007	(7-9') 7 to 9 1/8/2007
		Method	Units								
Volatle Organic Compounds (VOCs)		SW 8260	mg/kg								
Carbon tetrachloride			< 0.1		< 0.075						
Chloroethane			< 0.26		< 0.19						
Chloroform			< 0.1		< 0.075						
1,1-Dichloroethane			< 0.1		< 0.075						
1,1-Dichloroethylene			< 0.1		< 0.075						
cis-1,2-Dichloroethylene			< 0.1		< 0.075						
trans-1,2-Dichloroethylene			< 0.1		< 0.075						
Tetrachloroethylene (PCE)			< 0.1		< 0.075						
1,1,1-Trichloroethane (TCA)			0.324		0.242						
Trichloroethylene (TCE)			< 0.1		< 0.075						
Vinyl chloride			< 0.1		< 0.075						

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1f
Risk Characterization Data - Soil
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW112		MW112A		MW114		MW115	SB121A
	Sample Name:		B112		B112A		MW114		MW115	MW-121A-Vac1
	Method	Units	B112-VAC-GRAB 3 to 3 1/4/2007	B112 (6-7") 6 to 7 1/8/2007	B112A (0-3") 0 to 3 3/10/2007	B112A (10-12") 10 to 12 3/10/2007	MW114 (2'-4') 2 to 4 2/13/2007	MW114 (11'-13") 11 to 13 2/15/2007	MW115 (2'-4') 2 to 4 2/13/2007	0 to 3 10/5/2007
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg								
Carbon tetrachloride			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
Chloroethane			< 0.27	< 0.28	< 0.31	< 0.2	< 0.28	< 0.22	< 0.31	< 0.24
Chloroform			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
1,1-Dichloroethane			< 0.11	< 0.11	0.13 J	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
cis-1,2-Dichloroethylene			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
trans-1,2-Dichloroethylene			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
Tetrachloroethylene (PCE)			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
1,1,1-Trichloroethane (TCA)			0.11 F+	< 0.11	0.13 J	0.0471 J	< 0.11	< 0.09	< 0.13	< 0.097
Trichloroethylene (TCE)			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097
Vinyl chloride			< 0.11	< 0.11	< 0.13	< 0.081	< 0.11	< 0.09	< 0.13	< 0.097

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- mg/kg = milligrams per kilogram.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 1f
Risk Characterization Data - Soil
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		MW121D				MW122	
	Method	Sample Depth (ft): Sample Date:	Sample Name:		MW121D-S3 10 to 12 10/6/2007	MW121D-S1 6 to 8 1/23/2008	B122-S3 10 to 12 1/24/2008	B122-S1
			MW121D-VAC1 1 to 3 10/5/2007	MW121D-VAC2 3 to 5 10/5/2007				
Volatile Organic Compounds (VOCs)	SW 8260	mg/kg						
Carbon tetrachloride			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
Chloroethane			< 0.27	< 0.32	< 0.33	< 0.27	< 0.27	< 0.27
Chloroform			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
1,1-Dichloroethane			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
1,1-Dichloroethylene			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
cis-1,2-Dichloroethylene			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
trans-1,2-Dichloroethylene			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
Tetrachloroethylene (PCE)			< 0.11	< 0.13	< 0.13	0.0257 J	< 0.11	< 0.11
1,1,1-Trichloroethane (TCA)			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
Trichloroethylene (TCE)			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11
Vinyl chloride			< 0.11	< 0.13	< 0.13	< 0.11	< 0.11	< 0.11

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. mg/kg = milligrams per kilogram.
4. NT = not tested.
5. FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2a
Risk Characterization Data - Groundwater
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Sample Location:		GEO-1				GEO-2		MW-1	
	Well Screen Interval (ft bgs):	Sample Date:	5 to 20		5 to 20		5 to 20		1/17/2007	
			1/17/2007	4/15/08	1/17/2007 (FD)	4/12/2007	1/17/2007	4/12/2007	1/17/2007	4/17/2007
	Method	Collected By:	GEI	GEI	GEI	GEI	GEI	GEI	GEI	GEI
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	8260		2.3	< 1.0	2.3	5.4	< 5.0	< 1.0	22.4	< 500
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 10	< 2.0	< 2.0	< 1000
Chloroform			0.60 J	< 1.0	0.61 J	1.5	< 5.0	< 1.0	1.6	< 500
Dichloroethane, 1,1-			5.4	< 1.0	5.6	10.6	< 5.0	2.5	59.9	< 500
Dichloroethylene, cis-1,2-			3.3	< 1.0	< 1.0	8.7	9	< 1.0	7.7	< 500
Dichloroethylene, 1,1-			247	3.0	241	8980	25.2	11.5	1260	2290
Tetrachloroethylene (PCE)			17300	135	18000	48500	1420	120	74900	49600
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	< 1.0	< 500
Trichloroethane, 1,1,1- (TCA)			13300	29.5	14200	42500 J+	867	147 J+	135000	151000
Trichloroethylene (TCE)			9090	18.9	9660	30600	602	36	120000	103000
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.0	1.2	< 500

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- SHA = Sanborn Head & Associates, Inc.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- E The reported value is estimated; reported from undiluted sample run due to sample non-homogeneity.
- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 2a
Risk Characterization Data - Groundwater
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW104						MW203	MW-3		
Analyte	Well Screen Interval (ft bgs): Sample Date:		5 to 15 4/13/2007		5 to 15 7/19/2007	5 to 15 10/15/2007	5 to 15 1/11/2008	5 to 15 4/15/08	GEI	unknown 1/17/2007	unknown 4/17/2007	unknown 4/15/08
	Method	Units	GEI	GEI	GEI	GEI	GEI					
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	GEI	GEI	GEI	GEI
Chloroethane			4.7	6.9	5.6	2.3	< 2.0	< 2.0	< 2.0	< 25	< 50	< 2.0
Chloroform			< 1.0	NT	< 1.0	< 1.0	< 1.0	NT	3.4	< 25	< 1.0	
Dichloroethane, 1,1-			46.8	68.3	86.6	38.7	33.0	22.2	< 1.0	< 25	< 1.0	
Dichloroethylene, cis-1,2-			250	194	279	148	145	102	1.9	< 25	< 1.0	
Dichloroethylene, 1,1-			10	2.6	4.5	1.7	1.8	76.4	5.6	< 25	< 1.0	
Tetrachloroethylene (PCE)			39.6	31.2	49.3	12.1	22.4	15500	51900	6550	400	
Trans-1,2-Dichloroethylene			3.6	2.5	4.1	3.5	2.0	1.2	< 1.0	< 25	< 1.0	
Trichloroethane, 1,1,1- (TCA)			5.6 J+	28	89.8	12.5	10.8	1710	68.7	11.1 J	< 1.0	
Trichloroethylene (TCE)			51.4	40.4	< 1.0	27	34.9	979	247	13.8 J	1.9	
Vinyl chloride			40.4	38.2	68.0	26.4	29.9	< 1.0	< 1.0	< 25	< 1.0	

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. SHA = Sanborn Head & Associates, Inc.
6. NT = not tested.
7. FD = field duplicate sample.

Qualifying Notes:

- E The reported value is estimated; reported from undiluted sample run due to sample non-homogeneity.
- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 2a
Risk Characterization Data - Groundwater
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Sample Location:		SH-MW1		SH-MW2		SH-MW3	
	Well Screen Interval (ft bgs):	Method	10 to 30	10 to 30	10 to 25	10 to 25	10 to 24	10 to 24
	Sample Date:		1/16/2007	4/12/2007	1/16/2007	4/16/2007	1/17/2007	4/12/2007
Collected By:		Units	GEI	GEI	GEI	GEI	GEI	GEI
Volatile Organic Compounds (VOCs)								
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 4.0	< 2.0	< 2.0
Chloroform			1.7	3.4	< 1.0	< 2.0	< 100	< 100
Dichloroethane, 1,1-			8.5	12.7	5.7	< 2.0	< 100	< 100
Dichloroethylene, cis-1,2-			11.2	2.7	14.7	1.4 J	< 100	< 100
Dichloroethylene, 1,1-			9	24.4	9.8	2.1	< 100	< 100
Tetrachloroethylene (PCE)			31700 F+	48900	2880 F+	726	29700	15200
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 2.0	< 100	< 100
Trichloroethane, 1,1,1- (TCA)			31.4	27.9 J+	360	44.1	806	119
Trichloroethylene (TCE)			141	159	171	26.5	709	306
Vinyl chloride			< 1.0	0.55 J	< 1.0	< 2.0	< 100	< 100

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. SHA = Sanborn Head & Associates, Inc.
6. NT = not tested.
7. FD = field duplicate sample.

Qualifying Notes:

- E The reported value is estimated; reported from undiluted sample run due to sample non-homogeneity.
- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 2b
Risk Characterization Data - Groundwater
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW201			
Well Screen Interval (ft bgs): Sample Date: Collected By:			11 to 21 7/19/2007 GEI	11 to 21 10/12/2007 GEI	11 to 21 1/11/2008 GEI	11 to 21 4/15/08 GEI
Analyte	Method	Units				
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			NT	0.47 J	0.40 J	0.24 J
Dichloroethane, 1,1-			< 1.0	0.66 J	< 1.0	0.23 J
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			4.7	4.9	5.2	3.0
Tetrachloroethylene (PCE)			5.1	19.6	25.8	18.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			9.8	36.3	32.9	7.3
Trichloroethylene (TCE)			4.5	7.2	8.2	6.4
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2b
Risk Characterization Data - Groundwater
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

MW202						
Sample Location:			10.5 to 20.5 7/19/2007 GEI	10.5 to 20.5 10/12/2007 GEI	10.5 to 20.5 1/11/2008 GEI	10.5 to 20.5 4/15/08 GEI
Analyte	Well Screen Interval (ft bgs):		Units			
	Sample Date:	Collected By:				
	Method					
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			NT	< 1.0	< 1.0	< 1.0
Dichloroethane, 1, 1-			0.50 J	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1, 2-			< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1, 1-			1.1	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			17.2	14.6	21.8	55.6
Trans-1, 2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1, 1, 1- (TCA)			12.5	4.4	4.2	35.2
Trichloroethylene (TCE)			2.2	1.5	1.6	6.9
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2c
Risk Characterization Data - Groundwater
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			GEO-4		GEO-5		GEO-6		
Analyte	Well Screen Interval (ft bgs):		GEO-4	GEO-5	GEO-5	GEO-6	GEO-6(FD)	GEO-6	GEO-6
	Sample Name:	Sample Date:	4 to 19 1/16/2007	4 to 19 4/16/2007	5 to 20 1/16/2007	5 to 20 1/16/2007	5 to 20 1/16/2007	5 to 20 4/16/2007	5 to 20 4/16/2007
	Method	Units							
Volatile Organic Compounds (VOCs)			SW 8260						
Carbon tetrachloride		µg/l	< 20	< 10	< 50	< 1.0	< 1.0	< 2.0	< 1.0
Chloroethane			< 40	< 20	< 100	< 2.0	< 2.0	< 4.0	< 2.0
Chloroform			< 20	< 10	< 50	< 1.0	< 1.0	< 2.0	< 1.0
1,1-Dichloroethane			< 20	< 10	< 50	< 1.0	< 1.0	0.92 J	1.1
1,1-Dichloroethylene			< 20	< 10	< 50	< 1.0	< 1.0	2.8	3.8
cis-1,2-Dichloroethylene			< 20	5.5 J	< 50	< 1.0	< 1.0	5.3	6.3
trans-1,2-Dichloroethylene			< 20	< 10	< 50	< 1.0	< 1.0	< 2.0	< 1.0
Tetrachloroethylene (PCE)			16700	8240	254 F+	17.9	594 F+	618	497
1,1,1-Trichloroethane (TCA)			113	70.9	< 50	< 1.0	25.3	21.2	26.8
Trichloroethylene (TCE)			129	74.8	< 50	< 1.0	56.5	55.5	70.5
Vinyl chloride			< 20	< 10	< 50	< 1.0	< 1.0	< 2.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2c
Risk Characterization Data - Groundwater
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW109	
Analyte	Sample Name:	MW109	MW109	MW109
	Well Screen Interval (ft bgs):	3 to 13	3 to 13	3 to 13
	Sample Date:	1/18/2007	4/16/2007	4/17/08
Method	Units			
SW 8260	µg/l			
Volatile Organic Compounds (VOCs)				
Carbon tetrachloride		< 1.0	< 1.0	< 1.0
Chloroethane		< 2.0	< 2.0	< 2.0
Chloroform		< 1.0	< 1.0	< 1.0
1,1-Dichloroethane		1.2	< 1.0	< 1.0
1,1-Dichloroethylene		< 1.0	< 1.0	< 1.0
cis-1,2-Dichloroethylene		< 1.0	< 1.0	< 1.0
trans-1,2-Dichloroethylene		< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)		< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane (TCA)		178 F-	28.5	17.4
Trichloroethylene (TCE)		0.77 J	0.97 J	0.31 J
Vinyl chloride		4.5	< 1.0	0.52 J
		< 1.0	< 1.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "<" = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- NT = not tested.
- FD = field duplicate sample.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2d
Risk Characterization Data - Groundwater
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW105				
		19 to 29 1/17/2007 GEI	19 to 29 4/16/2007 GEI	19 to 29 7/19/2007 GEI	19 to 29 10/10/2007 GEI	19 to 29 1/9/2008 GEI
Analyte	Method	Units				
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	8260	µg/l				
Chloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichloroethane, 1,1-		< 1.0	< 1.0	NT	< 1.0	< 1.0
Dichloroethylene, cis-1,2-		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene		0.67 J	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)		3.2	1.5	1.5	1.6	2.2
Vinyl chloride		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2d
Risk Characterization Data - Groundwater
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:			MW114			MW114 (continued)		
Analyte	Method	Units	7 to 17 2/20/2007 GEI	7 to 17 4/13/2007 GEI	7 to 17 7/18/2007 GEI	7 to 17 10/10/2007 GEI	7 to 17 1/11/2008 GEI	7 to 17 4/17/08 GEI
Volatile Organic Compounds (VOCs)								
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0	< 1.0	NT	< 1.0	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2d
Risk Characterization Data - Groundwater
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

MW115									
Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:				10 to 25 3/23/2007 GEI	10 to 25 4/13/2007 GEI	10 to 25 7/18/2007 GEI	10 to 25 10/10/2007 GEI	10 to 25 1/9/2008 GEI	10 to 25 4/17/08 GEI
Analyte	Method	Units							
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0	< 1.0	NT	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "<" = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Sample Location:		GEO-3		MW101		
	Well Screen Interval (ft bgs):	Method	5 to 20 1/16/2007 GEI	5 to 20 4/13/2007 GEI	9 to 19 1/17/2007 GEI	9 to 19 4/13/2007 GEI	9 to 19 4/13/2007 (FD) GEI
	Sample Date: Collected By:	Units					
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0	< 1.0	< 1.0	< 1.0	1.8
Dichloroethane, 1,1-			2.6	< 1.0	< 1.0	< 1.0	1.6
Dichloroethylene, cis-1,2-			1.2	< 1.0	1.3	< 1.0	2.1 G
Dichloroethylene, 1,1-			11.5	1.4	14.1	< 1.0	4.6 G
Tetrachloroethylene (PCE)			529	93.2	192	94	90.7
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			16.2	< 1.0	131	50.5 J+	43.0 J+
Trichloroethylene (TCE)			70.2	10	38.4	47.2	45.7
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
G The result is estimated due to duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Sample Location:		MW102					
		Method	Units	Well Screen Interval (ft bgs):					
				Sample Date:					
Collected By:		6 to 16 1/16/2007 GEI	6 to 16 4/13/2007 GEI	6 to 16 7/18/2007 GEI	6 to 16 10/10/2007 GEI	6 to 16 1/10/2008 GEI	6 to 16 4/17/08 GEI		
Volatile Organic Compounds (VOCs)		8260	µg/l	< 1.0 < 2.0 < 1.0 < 1.0 < 1.0 30 692 < 1.0 32.6 57 < 1.0	< 1.0 < 2.0 < 1.0 < 1.0 < 1.0 < 1.0 20.3 < 1.0 < 1.0 2 < 1.0	< 1.0 < 2.0 NT 0.42 J < 1.0 23.6 524 < 1.0 26.3 46.1 < 1.0	< 2.0 < 4.0 < 2.0 2.1 < 2.0 39.7 685 < 2.0 69.8 61.0 < 2.0	< 1.0 < 2.0 < 1.0 4.1 < 1.0 51.8 606 < 1.0 121 65.3 < 1.0	< 1.0 < 2.0 < 1.0 0.51 J < 1.0 22.2 C+ 438 C+ < 1.0 21.9 C+ 35.6 C+ < 1.0
Carbon tetrachloride									
Chloroethane									
Chloroform									
Dichloroethane, 1,1-									
Dichloroethylene, cis-1,2-									
Dichloroethylene, 1,1-									
Tetrachloroethylene (PCE)									
Trans-1,2-Dichloroethylene									
Trichloroethane, 1,1,1- (TCA)									
Trichloroethylene (TCE)									
Vinyl chloride									

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
G The result is estimated due to duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW103			
		6 to 16 1/16/2007 GEI	6 to 16 1/16/2007 GEI	6 to 16 1/18/2007 GEI	6 to 16 4/13/2007 GEI
Analyte	Method	Units			
Volatile Organic Compounds (VOCs)					
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 5.0
Chloroethane			< 2.0	6.1	< 10
Chloroform			0.65 J	< 1.0	< 5.0
Dichloroethane, 1,1-			11.5	57.1	7.9
Dichloroethylene, cis-1,2-			< 1.0	244	< 5.0
Dichloroethylene, 1,1-			4.3	2.9	8
Tetrachloroethylene (PCE)			1200 F+	29.3	1510
Trans-1,2-Dichloroethylene			< 1.0	6.2	< 5.0
Trichloroethane, 1,1,1- (TCA)			17.6	23.2	< 5.0
Trichloroethylene (TCE)			37	49.1	58.7
Vinyl chloride			< 1.0	47.4	< 5.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
G The result is estimated due to duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Sample Location:		MW106						MW110	
	Well Screen	Interval (ft bgs):	9 to 19		9 to 19		9 to 19		3 to 13	
	Method	Units	1/18/2007 GEI	4/13/2007 GEI	7/19/2007 GEI	10/10/2007 GEI	1/10/2008 GEI	9 to 19 4/17/08 GEI	1/18/2007 GEI	3 to 13 4/17/2007 GEI
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			1.1	1.2	NT	0.56 J	0.39 J	1.7	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			4.4	6.3	3.4	3.9	4.1	1.5	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			1.0 F-	1.2	2.3	1.7	2.3	0.44 J	0.89 J F-	0.93 J
Trichloroethane, 1,1,1- (TCA)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)			15.3	1.5 J+	6.4	11.3	14.9	2.3	< 1.0	< 1.0
Vinyl chloride			3.7	4.8	3.6	4.4	4.9	1.2	< 1.0	< 1.0
			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
G The result is estimated due to duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW111				
Well Screen Interval (ft bgs):			4 to 14	4 to 14	4 to 14	4 to 14	4 to 14
Sample Date:			1/18/2007	4/16/2007	7/18/2007	10/10/2007	1/10/2008
Collected By:			GEI	GEI	GEI	GEI	GEI
Analyte	Method	Units					
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	8260	µg/l	< 10	< 25	< 1.0	< 50	< 1.0
Chloroethane			< 20	< 50	< 2.0	< 100	< 2.0
Chloroform			< 10	< 25	NT	< 50	1.2
Dichloroethane, 1,1-			30.9	15.7 J	16.8	19.1 J	5.6
Dichloroethylene, cis-1,2-			22.6	17.2 J	56.3	63.9	10.6
Dichloroethylene, 1,1-			17.6	< 25	10.5	< 50	4.1
Tetrachloroethylene (PCE)			13700 F-	7370	6340	8350	3100
Trans-1,2-Dichloroethylene			< 10	< 25	1.5	< 50	< 1.0
Trichloroethane, 1,1,1- (TCA)			142	56.5	89.1	84.1	41.3
Trichloroethylene (TCE)			150	84.4	120	125	42.1
Vinyl chloride			< 10	< 25	< 1.0	< 50	< 1.0
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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:		MW112A				
		4 to 19 3/23/2007 GEI	4 to 19 4/16/2007 GEI	4 to 19 7/18/2007 GEI	4 to 19 10/10/2007 GEI	4 to 19 1/10/2008 GEI
Analyte	Well Screen Interval (ft bgs): Sample Date: Collected By:	Method	Units			
Volatile Organic Compounds (VOCs)		8260	µg/l			
Carbon tetrachloride				< 1.0	< 1.0	< 1.0
Chloroethane				< 2.0	< 2.0	< 2.0
Chloroform				0.35 J	< 1.0	< 1.0
Dichloroethane, 1,1-				27.6	24	40.9 C+
Dichloroethylene, cis-1,2-				< 1.0	0.54 J	55.3 C+
Dichloroethylene, 1,1-				19.7	10.8	36.6 C+
Tetrachloroethylene (PCE)				261	198	202 C+
Trans-1,2-Dichloroethylene				< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)				1.3	0.96 J	1.9 C+
Trichloroethylene (TCE)				34	36.1	72.8 C+
Vinyl chloride				0.84 J	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
- F- The result has a low bias due to matrix spike recovery below lower control limits.
- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW116									
		5 to 15 3/23/2007 GEI	5 to 15 4/16/2007 GEI	5 to 15 7/18/2007 GEI	5 to 15 7/18/2007 GEI	5 to 15 7/18/2007 GEI	5 to 15 10/12/2007 GEI	5 to 15 10/12/2007 GEI	5 to 15 1/11/2008 GEI	5 to 15 4/15/08 GEI	5 to 15 4/15/08 (FD) GEI
Analyte	Method	Units									
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride	8260	µg/l									
Chloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Chloroform		< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	2.4 J	< 2.0	< 2.0	< 2.0	< 2.0
Dichloroethane, 1,1-		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	NT	< 2.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-		135	4.4	97.3	96.9	96.9	80.1	79.3	18.9	66.8	64.5
Dichloroethylene, 1,1-		103	21.7	415	431	431	346	341	49.5	105	102
Tetrachloroethylene (PCE)		107	2.7	33.8	34	34	24.8	22.4	14.7	46.3	45.7
Trans-1,2-Dichloroethylene		1180	32.2	167	168	168	116	110	267	603	607
Trichloroethane, 1,1,1- (TCA)		1.8	< 1.0	4.3	4.4	4.4	2.5	2.4	0.88 J	< 1.0	< 1.0
Trichloroethylene (TCE)		21.6	0.67 J	10.6	10.7	10.7	9.4	9.2	3.3	10.7	10.7
Vinyl chloride		358	19.4	72.7	73.2	73.2	136	129	66.3	175	174
		14.1	3.2	185	182	182	84.9	76.4	3.1	2.6	2.7

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Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
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G The result is estimated due to duplicate precision outside control limits.
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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:		MW118D			
Well Screen Interval (ft bgs):		70 to 80	70 to 80	70 to 80	70 to 80
Sample Date:		7/20/2007	8/30/2007	10/11/2007	1/16/2008
Collected By:		GEI	GEI	GEI	GEI
Analyte	Method	Units			
Volatile Organic Compounds (VOCs)					
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0
Chloroform			NT	< 1.0	< 1.0
Dichloroethane, 1,1-			20.3	31.2	33.3
Dichloroethylene, cis-1,2-			0.55 J	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			7	8.2	5.7
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)			1.2	1.8	1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0

General Notes:

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- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: MW118S						
Well Screen Interval (ft bgs):			3 to 14	3 to 14	3 to 14	3 to 14
Sample Date:			7/20/2007	8/30/2007	10/11/2007	1/11/2008
Collected By:			GEI	GEI	GEI	GEI
Analyte	Method	Units				
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			NT	NT	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)			0.39 J	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)			< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

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- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

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F- The result has a low bias due to matrix spike recovery below lower control limits.
G The result is estimated due to duplicate precision outside control limits.
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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW118T				
		39.5 to 49.5 7/20/2007 GEI	39.5 to 49.5 8/30/2007 GEI	39.5 to 49.5 10/11/2007 GEI	39.5 to 49.5 1/15/2008 GEI	39.5 to 49.5 4/16/08 GEI
Analyte	Method	Units				
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride	8260	µg/l				
Chloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichloroethane, 1,1-		NT	NT	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-		35.4	34.4	44.2	42.3	42.0
Dichloroethylene, 1,1-		0.45 J	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE)		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene		3	3.8	2.2	2.9	2.7
Trichloroethane, 1,1,1- (TCA)		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)		< 1.0	< 1.0	< 1.0	0.31 J	< 1.0
Vinyl chloride		< 1.0	2.3	< 1.0	< 1.0	< 1.0

General Notes:

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3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

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G The result is estimated due to duplicate precision outside control limits.
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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW119S				MW119T			
		5 to 20 8/22/2007 GEI	5 to 20 10/12/2007 GEI	5 to 20 1/15/2008 GEI	5 to 20 4/16/08 GEI	42 to 47 8/22/2007 GEI	42 to 47 10/12/2007 GEI	42 to 47 1/16/2008 GEI	42 to 47 4/16/08 GEI
Analyte	Method	Units							
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	8260	µg/l	< 1.0 J+	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0 J+	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0 J+	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0 J+	< 1.0	< 1.0	< 1.0	10.4 J+	10.9	10.4
Dichloroethylene, cis-1,2-			< 1.0 J+	< 1.0	< 1.0	< 1.0	0.54 J+	1.2	1.2
Dichloroethylene, 1,1-			< 1.0 J+	< 1.0	< 1.0	< 1.0	2	6.0	6.2
Tetrachloroethylene (PCE)			< 1.0 J+	< 1.0	< 1.0	< 1.0	94.3 J+	85.0	86.3
Trans-1,2-Dichloroethylene			< 1.0 J+	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1- (TCA)			< 1.0 J+	< 1.0	< 1.0	< 1.0	< 1.0	0.52 J	< 1.0
Trichloroethylene (TCE)			< 1.0 J+	< 1.0	< 1.0	< 1.0	25.9 J+	26.7	26.8
Vinyl chloride			< 1.0 J+	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW120D				MW120S			
		28 to 38 8/22/2007 GEI	28 to 38 10/12/2007 GEI	28 to 38 1/17/2008 GEI	28 to 38 4/16/08 GEI	5 to 20 8/22/2007 GEI	5 to 20 10/12/2007 GEI	5 to 20 1/15/2008 GEI	5 to 20 4/16/08 GEI
Analyte	Method	Units							
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	8260	µg/l							
Chloroethane									
Chloroform									
Dichloroethane, 1,1-									
Dichloroethylene, cis-1,2-									
Dichloroethylene, 1,1-									
Tetrachloroethylene (PCE)									
Trans-1,2-Dichloroethylene									
Trichloroethane, 1,1,1- (TCA)									
Trichloroethylene (TCE)									
Vinyl chloride									

General Notes:

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Attachment C 2e
Risk Characterization Data - Groundwater
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Method	Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:	MW121D			MW121S			MW122	
			32.1 to 47.1 10/22/2007 GEI	32.1 to 47.1 1/15/2008 GEI	32.1 to 47.1 4/17/08 GEI	5 to 20 10/22/2007 GEI	5 to 20 1/15/2008 GEI	5 to 20 4/17/08 GEI	4 to 16 1/30/2008 GEI	4 to 16 4/17/08 GEI
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 4.0
Chloroform			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Dichloroethane, 1,1-			46.3	55.3	46.6	< 1.0	< 1.0	< 1.0	19.3	30.4 C+
Dichloroethylene, cis-1,2-			3.9	11.8	6.4	< 1.0	< 1.0	< 1.0	60.6	70.7 C+
Dichloroethylene, 1,1-			13.2	< 1.0	16.7	< 1.0	< 1.0	< 1.0	4.0	9.0 C+
Tetrachloroethylene (PCE)			182	258	177	< 1.0	< 1.0	< 1.0	477	691 C+
Trans-1,2-Dichloroethylene			< 1.0	0.70 J	< 1.0	< 1.0	< 1.0	< 1.0	0.87 J	< 2.0
Trichloroethane, 1,1,1- (TCA)			1.2	1.3	1.2	< 1.0	< 1.0	< 1.0	1.4	3.4 C+
Trichloroethylene (TCE)			59.6	136	68.8	< 1.0	< 1.0	< 1.0	177	106 C+
Vinyl chloride			0.39 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.32 J	< 2.0

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Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:			GEO-3						
Analyte	Method	Units	5 to 20 8/16/2004 Geolnsight	5 to 20 5/24/2006 GEI	5 to 20 5/24/2006 GEI	5 to 20 10/4/2006 GEI	5 to 20 (FD) GEI	5 to 20 1/16/2007 GEI	5 to 20 4/13/2007 GEI
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	8260	µg/l	< 50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 100	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethane, 1,1-			< 50	< 1.0	< 1.0	11.6	11.6	2.6	< 1.0
Dichloroethylene, 1,1-		108	< 1.0	< 1.0	< 1.0	59.3	59.1	11.5	1.4
Dichloroethylene, cis-1,2-		< 50	< 1.0	< 1.0	< 1.0	2.8	2.6	1.2	< 1.0
Trans-1,2-Dichloroethylene		< 50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene		4020	162	157	157	2720	2340	529	93.2
Trichloroethane, 1,1,1-		204	4	4.4	4.4	78.2 J+	77.2 J+	16.2	< 1.0
Trichloroethylene		507	14.4	14.1	14.1	209	207	70.2	10
Vinyl chloride		< 50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

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Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		GEO-4					GEO-5				
		4 to 19 8/16/2004 GeoInsight	4 to 19 5/24/2006 GEI	4 to 19 10/4/2006 GEI	4 to 19 1/16/2007 GEI	4 to 19 4/16/2007 GEI	5 to 20 8/16/2004 GeoInsight	5 to 20 5/24/2006 GEI	5 to 20 10/4/2006 GEI	5 to 20 1/16/2007 GEI	5 to 20 4/16/2007 GEI
Analyte	Method	Units									
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 20	< 10	< 100	< 1.0	< 1.0	< 50	< 1.0
Chloroethane			< 2.0	< 2.0	< 40	< 20	< 200	< 2.0	< 2.0	< 100	< 2.0
Chloroform			< 1.0	2.5	< 20	< 10	< 100	< 1.0	0.62 J	< 50	< 1.0
Dichloroethane, 1,1-			2.7	7.1	< 20	< 10	< 100	3	9.7	< 50	< 1.0
Dichloroethylene, 1,1-			6.1	17.8	< 20	< 10	< 100	8.9	32.7	< 50	< 1.0
Dichloroethylene, cis-1,2-			6.3	16.7	< 20	5.5 J	< 100	12.5	35.2	< 50	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 20	< 10	< 100	< 1.0	< 1.0	< 50	< 1.0
Tetrachloroethylene			6690	24100	16700	8240	14400	2440	12900	254 F+	17.9
Trichloroethane, 1,1,1-			113	321 J+	113	70.9	646	246	652	< 50	< 1.0
Trichloroethylene			86.8	235	129	74.8	404	146	446	< 50	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 20	< 10	< 100	< 1.0	< 1.0	< 50	< 1.0

General Notes:

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2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

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F- The result has a low bias due to matrix spike recovery below lower control limits.
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J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:												
Well Screen Interval (ft bgs):												
Sample Date:												
Collected By:												
Analyte	Method	Units	5 to 20 8/16/2004 GeoInsight	5 to 20 5/24/2006 GEI	5 to 20 10/4/2006 GEI	5 to 20 1/16/2007 GEI	5 to 20 1/16/2007(FD) GEI	5 to 20 4/16/2007 GEI	5 to 20 4/16/2007 GEI			
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	8260	µg/l	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0		
Chloroethane			< 20	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 4.0	< 2.0		
Chloroform			< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0		
Dichloroethane, 1,1-			< 10	2	4.4	1.7	1.6	1.6	0.92 J	1.1		
Dichloroethylene, 1,1-			< 10	4.6	11	4.4	3.2	2.8	3.8	3.8		
Dichloroethylene, cis-1,2-			< 10	9.1	15.4	7.7	6.9	5.3	6.3	6.3		
Trans-1,2-Dichloroethylene			< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0		
Tetrachloroethylene			782	675	1980	632	594 F+	618	497	497		
Trichloroethane, 1,1,1-			27.8	42.5	77.2 J+	33.7	25.3	21.2	26.8	26.8		
Trichloroethylene			122	78.8	131	75.3	56.5	55.5	70.5	70.5		
Vinyl chloride			< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0		

General Notes:

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2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

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Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:		MW102						
		Well Screen Interval (ft bgs):	6 to 16	6 to 16	6 to 16	6 to 16	6 to 16	6 to 16
Sample Date:		5/24/2006	10/5/2006	1/16/2007	4/13/2007	7/18/2007	10/10/2007	1/10/2008
Collected By:		GEI	GEI	GEI	GEI	GEI	GEI	GEI
Analyte	Method	Units						
Volatile Organic Compounds (VOCs)								
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 4.0	< 2.0
Chloroform			< 1.0	< 1.0	< 1.0	NT	< 2.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	0.42 J	2.1	4.1
Dichloroethylene, 1,1-			6.3	30	< 1.0	23.6	39.7	51.8
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0
Tetrachloroethylene			200	898	692	524	685	606
Trichloroethane, 1,1,1-			< 1.0	65.7 J+	32.6	26.3	69.8	121
Trichloroethylene			15.6	89.1	57	46.1	61.0	65.3
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:		MW103					
		6 to 16 5/24/2006 GEI	6 to 16 8/7/2006 GEI	6 to 16 10/5/2006 GEI	6 to 16 1/16/2007 GEI	6 to 16 1/18/2007 GEI	6 to 16 4/13/2007 GEI
Analyte	Method	Units					
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	8260	µg/l					
Chloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Chloroform		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 10
Dichloroethane, 1,1-		< 1.0	< 1.0	< 1.0	0.65 J	0.62 J	< 5.0
Dichloroethylene, 1,1-		27.2	3.7	13	11.5	10.1	7.9
Dichloroethylene, cis-1,2-		13.4	2	6.5	4.3	4.3	8
Trans-1,2-Dichloroethylene		< 1.0	3	2.5	< 1.0	< 1.0	< 5.0
Tetrachloroethylene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Trichloroethane, 1,1,1-		2600	592	1510	1200 F+	1250 F-	1510
Trichloroethylene		34	4.4	14.4 J+	17.6	21	< 5.0
Vinyl chloride		109	24	60.4	37	38	58.7
		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

MW105													
Sample Location:													
Well Screen Interval (ft bgs):													
Sample Date:													
Collected By:													
Analyte	Method	Units	19 to 29 5/24/2006 GEI	19 to 29 10/5/2006 GEI	19 to 29 1/17/2007 GEI	19 to 29 4/16/2007 GEI	19 to 29 7/19/2007 GEI	19 to 29 10/10/2007 GEI	19 to 29 1/9/2008 GEI	19 to 29 4/18/08 GEI			
Volatile Organic Compounds (VOCs)													
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0			
Chloroform			< 1.0	< 1.0	< 1.0	< 1.0	NT	< 1.0	< 1.0	< 1.0			
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Tetrachloroethylene			7.8	0.69 J	0.67 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Trichloroethane, 1,1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			
Trichloroethylene			< 1.0	3.4	3.2	1.5	1.5	1.6	2.2	1.7			
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0			

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f

Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Well Screen Interval (ft bgs): Sample Date: Collected By:			MW110		MW111							
			3 to 13 1/18/2007 GEI	3 to 13 4/17/2007 GEI	4 to 14 1/18/2007 GEI	4 to 14 4/16/2007 GEI	4 to 14 7/18/2007 GEI	4 to 14 10/10/2007 GEI	4 to 14 1/10/2008 GEI	4 to 14 4/17/08 GEI		
Analyte	Method	Units										
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 10	< 25	< 1.0	< 50	< 1.0	< 50	< 1.0	< 2.0
Chloroethane			< 2.0	< 2.0	< 20	< 50	< 2.0	< 100	< 2.0	< 4.0		
Chloroform			< 1.0	< 1.0	< 10	< 25	NT	< 50	1.2	< 2.0		
Dichloroethane, 1,1-			< 1.0	< 1.0	30.9	15.7 J	16.8	19.1 J	5.6	4.3 C+		
Dichloroethylene, 1,1-			< 1.0	< 1.0	17.6	< 25	10.5	< 50	4.1	4.4 C+		
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	22.6	17.2 J	56.3	63.9	10.6	3.7 C+		
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 10	< 25	1.5	< 50	< 1.0	1160 C+		
Tetrachloroethylene			0.89 J F-	0.93 J	13700 F-	7370	6340	8350	3100	< 2.0		
Trichloroethane, 1,1,1-			< 1.0	< 1.0	142	56.5	89.1	84.1	41.3	17.6 C+		
Trichloroethylene			< 1.0	< 1.0	150	84.4	120	125	42.1	19.9 C+		
Vinyl chloride			< 1.0	< 1.0	< 10	< 25	< 1.0	< 50	< 1.0	< 2.0		

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Sample Location:		MW112A					
		Well Screen Interval (ft bgs):							
		Method	Units	4 to 19 3/23/2007 GEI	4 to 19 4/16/2007 GEI	4 to 19 7/18/2007 GEI	4 to 19 10/10/2007 GEI	4 to 19 1/10/2008 GEI	4 to 19 4/17/08 GEI
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride		8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane				< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform				0.35 J	< 1.0	NT	< 1.0	0.32 J	< 1.0
Dichloroethane, 1,1-				27.6	24	6.4	35.6	114	40.9 C+
Dichloroethylene, 1,1-				19.7	10.8	6.7	19.7	82.4	55.3 C+
Dichloroethylene, cis-1,2-				< 1.0	0.54 J	0.98 J	4.2	18.7	36.6 C+
Trans-1,2-Dichloroethylene				< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	202 C+
Tetrachloroethylene				261	198	144	159	359	< 1.0
Trichloroethane, 1,1,1-				1.3	0.96 J	0.68 J	1.4	5.8	1.9 C+
Trichloroethylene				34	36.1	26.7	61.3	142	72.8 C+
Vinyl chloride				0.84 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

1. Only analytes used in the risk characterization are reported here.
2. "< " = The analyte was not detected at a concentration above the specified reporting limit.
3. ft bgs = feet below ground surface.
4. µg/l = micrograms per liter.
5. FD = field duplicate sample.
6. NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW114				
Well Screen Interval (ft bgs):			7 to 17	7 to 17	7 to 17	7 to 17	7 to 17
Sample Date:			2/20/2007	7/18/2007	10/10/2007	1/11/2008	4/17/08
Collected By:			GEI	GEI	GEI	GEI	GEI
Analyte	Method	Units					
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0	NT	< 1.0	< 1.0	< 1.0
Dichloroethane,1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene,1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane,1,1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW115					
Well Screen Interval (ft bgs):			10 to 25	10 to 25	10 to 25	10 to 25	10 to 25	10 to 25
Sample Date:			3/23/2007	4/13/2007	7/18/2007	10/10/2007	1/9/2008	4/17/08
Collected By:			GEI	GEI	GEI	GEI	GEI	GEI
Analyte	Method	Units						
Volatile Organic Compounds (VOCs)								
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform			< 1.0	< 1.0	NT	< 1.0	< 1.0	< 1.0
Dichloroethane, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, 1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichloroethylene, cis-1,2-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,2-Dichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethane, 1,1,1-			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 2f
Risk Characterization Data - Groundwater
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location:			MW121D				MW121S		MW122	
Well Screen Interval (ft bgs):			32.1 to 47.1 10/22/2007 GEI	32.1 to 47.1 1/15/2008 GEI	32.1 to 47.1 4/17/08 GEI	5 to 20 10/22/2007 GEI	5 to 20 1/15/2008 GEI	5 to 20 4/17/08 GEI	4 to 16 1/30/2008 GEI	4 to 16 4/17/08 GEI
Sample Date:										
Collected By:										
Analyte	Method	Units								
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	8260	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Chloroethane			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 4.0
Chloroform			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Dichloroethane,1,1-			46.3	55.3	46.6	< 1.0	< 1.0	< 1.0	19.3	30.4 C+
Dichloroethylene,1,1-			13.2	< 1.0	6.4	< 1.0	< 1.0	< 1.0	4.0	70.7 C+
Dichloroethylene, cis-1,2-			3.9	11.8	16.7	< 1.0	< 1.0	< 1.0	60.6	9.0 C+
Trans-1,2-Dichloroethylene			< 1.0	0.70 J	177	< 1.0	< 1.0	< 1.0	0.87 J	691 C+
Tetrachloroethylene			182	258	< 1.0	< 1.0	< 1.0	< 1.0	477	< 2.0
Trichloroethane,1,1,1-			1.2	1.3	1.2	< 1.0	< 1.0	< 1.0	1.4	3.4 C+
Trichloroethylene			59.6	136	68.8	< 1.0	< 1.0	< 1.0	177	106 C+
Vinyl chloride			0.39 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.32 J	< 2.0

General Notes:

- Only analytes used in the risk characterization are reported here.
- "< " = The analyte was not detected at a concentration above the specified reporting limit.
- ft bgs = feet below ground surface.
- µg/l = micrograms per liter.
- FD = field duplicate sample.
- NT = not tested.

Qualifying Notes:

- F+ The result has a high bias due to matrix spike recovery above upper control limits.
F- The result has a low bias due to matrix spike recovery below lower control limits.
J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 3a
Risk Characterization Data - Soil Vapor
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

No Soil Vapor Samples Were Assessed Within the "Property" Exposure Area

Attachment C 3b
Risk Characterization Data - Soil Vapor
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location:		MW201						MW202						
	Sample ID:	Sample Date:	MW201-SG			MW201-SG			SVT-MW202S						
			10/19/2007			1/8/2008			4/14/2008						
			µg/m ³	ppbv		µg/m ³	ppbv		µg/m ³	ppbv		µg/m ³	ppbv		
Units:	Method														
Volatile Organic Compounds (VOCs)		TO-15													
Carbon tetrachloride				< 1.3	< 0.20	< 25	< 4.0	< 25	< 4.0	< 25	< 4.0	< 25	< 4.0	1.2 J	0.19 J
Chloroethane				1.2	0.45	< 11	< 4.0	< 11	< 4.0	< 11	< 4.0	< 11	< 4.0	2.3	0.88
Chloroform				NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane				3.1	0.76	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	40	9.9
1,1-Dichloroethylene				109	27.5	59.9	15.1	39	9.9	39	9.9	11 J	2.8 J	326	82.3
cis-1,2-Dichloroethylene				7.9	2.0	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	4.4	1.1
trans-1,2-Dichloroethylene				< 0.79	< 0.20	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	< 16	< 4.0	0.87	0.22
Tetrachloroethylene (PCE)				8000	1180	5160	761	4830	713	2550	376	7460	376	1100	1100
1,1,1-Trichloroethane (TCA)				1520	278	617	113	232	42.5	537	98.5	4340	98.5	796	796
Trichloroethylene (TCE)				1530	285	1300	241	656	122	253	47.0	393	47.0	73.2	73.2
Vinyl chloride				0.79	0.31	< 10	< 4.0	< 10	< 4.0	< 10	< 4.0	1.9	< 4.0	1.9	0.73

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3b
Risk Characterization Data - Soil Vapor
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location: Sample ID: Sample Date:			MW202 (continued)										
			MW202-SG 1/8/2008		60Tuft-SVT-MW202S 1/16/2008		60Tuft-SVT-MW202S 1/17/2008		60Tuft-SVT-MW202S 1/21/2008		MW202-SG 4/14/2008		
			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	
Analyte	Method	Units:											
Volatile Organic Compounds (VOCs)		TO-15											
Carbon tetrachloride	TO-15	< 25	< 4.0	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 13	< 2.0
Chloroethane		< 11	< 4.0	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 5.3	< 2.0
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane		23	5.8	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	3.6 J	0.89 J
1,1-Dichloroethylene		468	118	0.79	0.2	0.48 J	0.12 J	0.56 J	0.14 J	103	< 7.9	< 2.0	
cis-1,2-Dichloroethylene		< 16	< 4.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 7.9	< 2.0
trans-1,2-Dichloroethylene		< 16	< 4.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 7.9	< 2.0
Tetrachloroethylene (PCE)		5390	795	252	37.1	366	54	403	59.4	2160	318	< 5.1	< 2.0
1,1,1-Trichloroethane (TCA)		2280	418	28	5.1	27	4.9	35	6.4	878	161	< 5.1	< 2.0
Trichloroethylene (TCE)		575	107	2.0	11	2.0	11	2.7	15	123	22.8	< 5.1	< 2.0
Vinyl chloride		< 10	< 4.0	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 5.1	< 2.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3c
Risk Characterization Data - Soil Vapor
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location: Sample ID: Sample Date:		MW109									
		MW109 1/17/2007		MW109 4/10/2007		MW109-SG 10/9/2007		MW109-SG 1/7/2008		MW109-SG 4/14/2008	
		Units:		Units:		Units:		Units:		Units:	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method										
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride		< 130	< 20	< 63	< 10	< 13	< 2.0	< 25	< 4.0	< 25	< 4.0
Chloroethane		< 53	< 20	< 26	< 10	< 5.3	< 2.0	< 11	< 4.0	< 11	< 4.0
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane		< 81	< 20	< 40	< 10	< 8.1	< 2.0	< 16	< 4.0	< 16	< 4.0
1,1-Dichloroethylene		< 79	< 20	< 40	< 10	< 7.9	< 2.0	< 16	< 4.0	< 16	< 4.0
cis-1,2-Dichloroethylene		< 79	< 20	< 40	< 10	< 7.9	< 2.0	< 16	< 4.0	< 16	< 4.0
trans-1,2-Dichloroethylene		< 79	< 20	< 40	< 10	< 7.9	< 2.0	< 16	< 4.0	< 16	< 4.0
Tetrachloroethylene (PCE)		9020	1330	3950	582	18900	2780	3510	518	4850 G	715 G
1,1,1-Trichloroethane (TCA)		573	105	322	59.1	354	64.9	87.8	16.1	113	20.7
Trichloroethylene (TCE)		< 110	< 20	31 J	5.7 J	32	5.9	< 21	< 4.0	19 J	3.6 J
Vinyl chloride	< 51	< 20	< 26	< 10	< 5.1	< 2.0	< 10	< 4.0	< 10	< 4.0	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3d
Risk Characterization Data - Soil Vapor
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		MW114									
		Location:		MW114		SG-MW114		MW114-SG		MW114-SG	
		Sample ID:	Sample Date:	2/19/2007	4/10/2007	7/17/2007	10/9/2007	1/7/2008	4/14/2008	1/7/2008	4/14/2008
		Units:		ppbv		µg/m ³		ppbv		µg/m ³	
		Method									
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride				< 31		< 1.3		< 0.20		< 1.3	
Chloroethane				< 5.3		0.77		0.29		0.98	
Chloroform				NT		NT		NT		NT	
1,1-Dichloroethane				< 8.1		< 0.81		< 0.20		< 0.81	
1,1-Dichloroethylene				< 7.9		< 0.79		< 0.20		< 0.79	
cis-1,2-Dichloroethylene				< 7.9		< 0.79		< 0.20		< 0.79	
trans-1,2-Dichloroethylene				< 7.9		< 0.79		< 0.20		< 0.79	
Tetrachloroethylene (PCE)				< 14		12		1.7		13	
1,1,1-Trichloroethane (TCA)				< 11		< 1.1		< 0.20		0.52 J	
Trichloroethylene (TCE)				4		0.86 J		0.16 J		1.8	
Vinyl chloride				< 5.1		0.36 J		0.14 J		< 0.51	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3d
Risk Characterization Data - Soil Vapor
Alston Street Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		MW115												Method
		Location:		MW115		SG-MW115R		MW115-SG		MW115R-SG		MW115R-S9		
		Sample ID:		MW115		7/17/2007		10/16/2007		1/7/2008		4/14/2008		
		Sample Date:		4/10/2007		4/10/2007		10/16/2007		1/7/2008		4/14/2008		
Units:		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	
TO-15														
Volatile Organic Compounds (VOCs)														
Carbon tetrachloride		< 13	< 2.0	< 1.3	< 0.20	< 1.3	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	0.69 J	0.11 J	
Chloroethane		< 5.3	< 2.0	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
1,1-Dichloroethane		< 8.1	< 2.0	0.65 J	0.16 J	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	
1,1-Dichloroethylene		< 7.9	< 2.0	1.3	0.33	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	
cis-1,2-Dichloroethylene		< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	
trans-1,2-Dichloroethylene		< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	
Tetrachloroethylene (PCE)		42	6.2	12	1.8	< 1.4	< 0.20	71.2	10.5	14	2.0	2.1	0.31	
1,1,1-Trichloroethane (TCA)		< 11	< 2.0	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	
Trichloroethylene (TCE)		15	2.7	< 1.1	< 0.20	< 1.1	< 0.20	0.75 J	0.14 J	2.0	0.38	< 1.1	< 0.20	
Vinyl chloride		< 5.1	< 2.0	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location:		MW106											
	Sample ID:	Sample Date:	MW106		MW900		MW106		SG-MW106		MW106-SG		MW106-SG	
			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)														
Carbon tetrachloride			< 6.3	< 1.0	< 2.5	< 0.40	< 1.3	< 0.20	< 13	< 2.0	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane			< 2.6	< 1.0	< 1.1	< 0.40	< 0.53	< 0.20	< 5.3	< 2.0	< 0.53	< 0.20	< 0.53	< 0.20
Chloroform			NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane			12	3	3.7	0.92	2.6	0.64	8.1 G	2.0 G	11	2.8	1.2	0.29
1,1-Dichloroethylene			204	51.5	58.7	14.8	20	5.1	153 G	38.6 G	39	9.8	15	3.7
cis-1,2-Dichloroethylene			< 4.0	< 1.0	< 1.6	< 0.40	< 0.79	< 0.20	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene			< 4.0	< 1.0	< 1.6	< 0.40	< 0.79	< 0.20	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)			47	6.9	16	2.4	14	2.1	203 G	30.0 G	162	23.9	22	3.3
1,1,1-Trichloroethane (TCA)			520	95.3	170	31.2	70.4	12.9	406 G	74.5 G	802	147	71.5	13.1
Trichloroethylene (TCE)			69.9	13	22	4.1	18	3.3	127 G	23.6 G	149	27.8	21	3.9
Vinyl chloride			< 2.6	< 1.0	< 1.0	< 0.40	< 0.51	< 0.20	< 5.1	< 2.0	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Method	MW111													
		MW110		MW111				SG-MW111		MW111-SG		MW111-SG		MW111-S9	
		MW110		MW111		MW111		MW111		MW111-SG		MW111-SG		MW111-S9	
		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Location: Sample ID: Sample Date:		MW110 1/17/2007		MW111 1/17/2007		MW111 4/11/2007		SG-MW111 7/17/2007		MW111-SG 10/9/2007		MW111-SG 1/7/2008		MW111-S9 4/14/2008	
Units:		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
TO-15		< 1.3	< 0.20	< 1300	< 200	< 130	< 20	< 1300	< 200	< 7500	< 1200	< 130	< 20	< 25	< 4.0
Carbon tetrachloride		< 0.53	< 0.20	< 530	< 200	< 53	< 20	< 530	< 200	< 3200	< 1200	< 53	< 20	< 11	< 4.0
Chloroethane		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Chloroform		< 0.81	< 0.20	943	233	67.2 J	16.6 J	< 810	< 200	< 4900	< 1200	< 81	< 20	28	6.8
1,1-Dichloroethane		< 0.79	< 0.20	619 J	156 J	< 79	< 20	< 790	< 200	< 4800	< 1200	< 79	< 20	< 16	< 4.0
1,1-Dichloroethylene		< 0.79	< 0.20	< 790	< 200	46.4 J	11.7 J	< 790	< 200	< 4800	< 1200	35 J	8.8 J	16	4.1
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 790	< 200	< 79	< 20	< 790	< 200	< 4800	< 1200	< 79	< 20	< 16	< 4.0
trans-1,2-Dichloroethylene		< 1.4	< 0.20	269000	39700	52600	7760	178000 G	26200 G	1360000	200000	83400	12300	49600	7310
Tetrachloroethylene (PCE)		< 1.1	< 0.20	4650	853	715	131	2770	507	12800	2350	519	95.1	497	91.1
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	2600	484	466	86.7	1520	282	5590 J	1040 J	286	53.2	250	46.6
Trichloroethylene (TCE)		< 0.51	< 0.20	< 510	< 200	< 51	< 20	< 510	< 200	< 3100	< 1200	< 51	< 20	< 10	< 4.0
Vinyl chloride															

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	MW112											
	Location:			MW112A			SG-MW112A			MW112A-SG		
	Sample ID:			4/11/2007			7/17/2007			10/9/2007		
	Sample Date:			3/20/2007			7/17/2007			10/9/2007		
Method	MW112		MW112A		MW112A		SG-MW112A		MW112A-SG		MW112A-SG	
	1/17/2007		3/20/2007		4/11/2007		7/17/2007		10/9/2007		17/2008	
	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
	Units:											
TO-15												
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	0.69 J	0.11 J	< 63	< 10	< 130	< 20	< 13	< 2.0	< 25	< 4.0	< 25	< 4.0
Chloroethane	< 0.53	< 0.20	< 26	< 10	< 53	< 20	< 5.3	< 4.0	< 11	< 4.0	< 11	< 4.0
Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane	< 0.81	< 0.20	429	106	155	38.2	359 G	88.6 G	1150	284	2280	564
1,1-Dichloroethylene	< 0.79	< 0.20	821	207	318	80.3	777 G	196 G	2080	524	3400	857
cis-1,2-Dichloroethylene	< 0.79	< 0.20	< 40	< 10	< 79	< 20	< 7.9	< 2.0	40.8	10.3	360	90.9
trans-1,2-Dichloroethylene	< 0.79	< 0.20	< 40	< 10	< 79	< 20	< 7.9	< 2.0	< 16	< 4.0	< 16	< 4.0
Tetrachloroethylene (PCE)	2.8	0.41	6230	919	6240	920	8140	1200	11300	1660	17400	2570
1,1,1-Trichloroethane (TCA)	< 1.1	< 0.20	85.1	15.6	66.0 J	12.1 J	139 G	25.5 G	262	48.0	467	85.6
Trichloroethylene (TCE)	< 1.1	< 0.20	951	177	505	93.9	2030 G	377 G	3980	740	2930	546
Vinyl chloride	< 0.51	< 0.20	< 26	< 10	< 51	< 20	< 5.1	< 2.0	< 10	< 4.0	< 10	< 4.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

MW116											
Location:		MW116		SG-MW116		MW116-SG		MW116-SG		MW116-SG2	
Sample ID:		4/11/2007		7/17/2007		10/9/2007		1/30/2008		4/14/2008	
Sample Date:		3/20/2007		4/11/2007		7/17/2007		10/9/2007		4/14/2008	
Units:		ppbv		ppbv		ppbv		ppbv		ppbv	
Units:		µg/m³		µg/m³		µg/m³		µg/m³		µg/m³	
Analyte	Method	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
TO-15											
Volatile Organic Compounds (VOCs)	Carbon tetrachloride	< 63	< 10	< 130	< 20	< 13	< 2.0	< 13	< 2.0	< 25	< 4.0
	Chloroethane	< 26	< 10	< 53	< 20	28	10.6	91.8	34.8	< 11	< 4.0
	Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	1,1-Dichloroethane	378	93.5	923	228	1490 G	367 G	2550	629	482 G	365
	1,1-Dichloroethylene	876	221	1570	395	634 G	160 G	436	110	813 G	619
	cis-1,2-Dichloroethylene	254	64	2620	661	1740 G	438 G	4480	1130	702 G	265
	trans-1,2-Dichloroethylene	< 40	< 10	< 79	< 20	151	38.1	84.8	21.4	< 16	< 4.0
	Tetrachloroethylene (PCE)	11100	1630	21500 G	3170 G	25500 G	3760 G	9630	1420	6600 G	15700
	1,1,1-Trichloroethane (TCA)	192	35.2	492	90.2	1020 G	187 G	408	74.8	206	125
	Trichloroethylene (TCE)	2140	398	6400	1190	2620 G	488 G	2250	419	1830 G	1820
	Vinyl chloride	89	34.8	514	201	64.7	25.3	762	298	< 10	< 4.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "L" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Location:		MW118S							
		Sample ID:		SG-MW118S		SG-MW118S		MW118S-SG		MW118S-SG	
		Sample Date:		7/17/2007		8/30/2007		10/9/2007		1/8/2008	
		Units:		ppbv		µg/m ³		ppbv		µg/m ³	
		Method									
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride				4.8		2.2		0.35		2.1	
Chloroethane				< 0.53		< 0.53		< 0.20		< 0.53	
Chloroform				NT		NT		NT		NT	
1,1-Dichloroethane				< 0.81		< 0.81		< 0.20		< 0.81	
1,1-Dichloroethylene				< 0.79		< 0.79		< 0.20		< 0.79	
cis-1,2-Dichloroethylene				< 0.79		< 0.79		< 0.20		< 0.79	
trans-1,2-Dichloroethylene				< 0.79		< 0.79		< 0.20		< 0.79	
Tetrachloroethylene (PCE)				< 0.79		< 0.79		< 0.20		< 0.79	
1,1,1-Trichloroethane (TCA)				231		155		34.1		176	
Trichloroethylene (TCE)				8.2		6		1.5		7.6	
Vinyl chloride				2.1		< 1.1		0.39		< 1.1	
				< 0.51		< 0.51		< 0.20		< 0.51	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. * < = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3e
Risk Characterization Data - Soil Vapor
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Method	MW120S				MW121S				MW122			
		SG-120S 8/28/2007		MW120S-SG 10/16/2007		MW121S-SG 10/22/2007		MW121S-SG 1/8/2008		MW122-SG 1/30/2008		MW122-SG 4/14/2008	
		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Volatile Organic Compounds (VOCs)													
Carbon tetrachloride	TO-15	0.62 J	0.098 J	< 1.3	< 0.20	< 1.3	< 0.20	0.82 J	0.13 J	< 25	< 4.0	< 6.3	< 1.0
Chloroethane		0.58	0.22	1.0	0.38	< 0.53	< 0.20	< 0.53	< 0.20	< 11	< 4.0	< 2.6	< 1.0
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane		51.8	12.8	48.2	11.9	2.1	0.52	< 0.81	< 0.20	11 J	2.8 J	5.3	1.3
1,1-Dichloroethylene		1.1	0.29	0.75 J	0.19 J	0.67 J	0.17 J	< 0.79	< 0.20	12 J	3.0 J	2.8 J	0.71 J
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	9.1 J	2.3 J	4.8	1.2
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 16	< 4.0	< 4.0	< 1.0
Tetrachloroethylene (PCE)		18	2.7	< 1.4	< 0.20	2.0	0.30	1.8	0.26	5320	784	1340	197
1,1,1-Trichloroethane (TCA)		0.55 J	0.10 J	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 22	< 4.0	8.2	1.5
Trichloroethylene (TCE)		4.8	0.90	0.86 J	0.16 J	< 1.1	< 0.20	< 1.1	< 0.20	69.3	12.9	35	6.6
Vinyl chloride		0.51	0.20	0.74	0.29	1.8	0.72	< 0.51	< 0.20	< 10	< 4.0	< 2.6	< 1.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	MW106											
	Location:		Sample ID:		Sample Date:		Units:		Method			
	MW106		MW900		MW106		SG-MW106		MW106-SG		MW106-SG	
	1/18/2007	1/18/2007	1/18/2007	1/18/2007	4/10/2007	4/10/2007	7/17/2007	7/17/2007	10/9/2007	10/9/2007	1/7/2008	4/14/2008
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	< 2.6	< 1.0	< 1.1	< 0.40	< 0.53	< 0.20	< 5.3	< 2.0	4.2	1.6	< 0.53	< 1.3
Chloroethane	< 6.3	< 1.0	< 2.5	< 0.40	< 1.3	< 0.20	< 13	< 2.0	< 1.3	< 0.20	< 1.3	< 0.20
Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane	12	3	3.7	0.92	2.6	0.64	8.1 G	2.0 G	11	2.8	2.9	1.2
1,1-Dichloroethylene	< 4.0	< 1.0	< 1.6	< 0.40	< 0.79	< 0.20	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	0.29
cis-1,2-Dichloroethylene	204	51.5	58.7	14.8	20	5.1	153 G	38.6 G	280	70.7	39	15
trans-1,2-Dichloroethylene	520	95.3	170	31.2	70.4	12.9	406 G	74.5 G	802	147	169	< 0.20
Tetrachloroethylene (PCE)	< 4.0	< 1.0	< 1.6	< 0.40	< 0.79	< 0.20	< 7.9	< 2.0	1.7	0.44	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)	47	6.9	16	2.4	14	2.1	203 G	30.0 G	162	23.9	28	71.5
Trichloroethylene (TCE)	69.9	13	22	4.1	18	3.3	127 G	23.6 G	149	27.8	33	21
Vinyl chloride	< 2.6	< 1.0	< 1.0	< 0.40	< 0.51	< 0.20	< 5.1	< 2.0	1.7	0.68	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	MW110		MW111		SG-MW111		MW111-SG		MW111-SG		MW111-S9	
	MW110		MW111		7/17/2007		10/9/2007		1/7/2008		4/14/2008	
	1/17/2007	ppbv	1/17/2007	ppbv	μg/m ³	ppbv	μg/m ³	ppbv	μg/m ³	ppbv	μg/m ³	ppbv
Units:												
Method												
TO-15												
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	< 1.3	< 0.20	< 1300	< 200	< 1300	< 200	< 7500	< 1200	< 130	< 20	< 25	< 4.0
Chloroethane	< 0.53	< 0.20	< 530	< 200	< 530	< 200	< 3200	< 1200	< 53	< 20	< 11	< 4.0
Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane	< 0.81	< 0.20	943	233	< 810	< 200	< 4900	< 1200	< 81	< 20	28	6.8
1,1-Dichloroethylene	< 0.79	< 0.20	619 J	156 J	< 790	< 200	< 4800	< 1200	< 79	< 20	< 16	< 4.0
cis-1,2-Dichloroethylene	< 0.79	< 0.20	< 790	< 200	< 790	< 200	< 4800	< 1200	35 J	8.8 J	16	4.1
trans-1,2-Dichloroethylene	< 0.79	< 0.20	< 790	< 200	< 790	< 200	< 4800	< 1200	< 79	< 20	< 16	< 4.0
Tetrachloroethylene (PCE)	< 1.4	< 0.20	269000	39700	178000 G	26200 G	1360000	200000	83400	12300	49600	7310
1,1,1-Trichloroethane (TCA)	< 1.1	< 0.20	4650	853	2770	507	12800	2350	519	95.1	497	91.1
Trichloroethylene (TCE)	< 1.1	< 0.20	2600	484	1520	282	5590 J	1040 J	286	53.2	250	46.6
Vinyl chloride	< 0.51	< 0.20	< 510	< 200	< 510	< 200	< 3100	< 1200	< 51	< 20	< 10	< 4.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. μg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location:		MW112											
Analyte	Method	MW112		MW112A		MW112A		SG-MW112A		MW112A-SG		MW112A-SG	
		1/17/2007		3/20/2007		4/11/2007		7/17/2007		10/9/2007		1/7/2008	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatle Organic Compounds (VOCs)	TO-15												
Carbon tetrachloride		0.69 J	0.11 J	< 63	< 10	< 130	< 20	< 13	< 2.0	< 25	< 4.0	< 25	< 4.0
Chloroethane		< 0.53	< 0.20	< 26	< 10	< 53	< 20	< 5.3	< 2.0	< 11	< 4.0	< 11	< 4.0
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane		< 0.81	< 0.20	429	106	155	38.2	359 G	88.6 G	2280	564	449	111
1,1-Dichloroethylene		< 0.79	< 0.20	821	207	318	80.3	777 G	196 G	3400	857	476	120
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 40	< 10	< 79	< 20	< 7.9	< 2.0	360	90.9	38	9.6
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 40	< 10	< 79	< 20	< 7.9	< 2.0	< 16	< 4.0	< 16	< 4.0
Tetrachloroethylene (PCE)		2.8	0.41	6230	919	6240	920	8140	1200	17400	2570	6010 G	886 G
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	85.1	15.6	66.0 J	12.1 J	139 G	25.5 G	467	85.6	44	8.1
Trichloroethylene (TCE)		< 1.1	< 0.20	951	177	505	93.9	2030 G	377 G	2930	546	1210	225
Vinyl chloride		< 0.51	< 0.20	< 26	< 10	< 51	< 20	< 5.1	< 2.0	24	9.5	< 10	< 4.0

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "c" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	MW114									
	Location:		MW114		SG-MW114		MW114-SG		MW114-SG	
	Sample ID:	Sample Date:	2/19/2007		7/17/2007		10/9/2007		1/7/2008	
Units:			MW114		SG-MW114		MW114-SG		MW114-SG	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method										
TO-15										
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	< 5.3	< 2.0	0.77	0.29	< 0.53	< 0.20	3.7	1.4	0.98	< 1.3
Chloroethane	< 31	< 5.0	< 1.3	< 0.20	0.69 J	0.11 J	0.88 J	0.14 J	< 1.3	< 0.20
Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane	< 8.1	< 2.0	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
dis-1,2-Dichloroethylene	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene	< 11	< 2.0	< 1.1	< 0.20	0.76 J	0.14 J	2.3	0.43	0.52 J	< 0.20
Tetrachloroethylene (PCE)	< 7.9	< 2.0	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)	< 14	< 2.0	12	1.7	17	2.5	40	5.9	13	< 1.1
Trichloroethylene (TCE)	4	0.75	0.86 J	0.16 J	1.5	0.27	7.5	1.4	1.8	0.37
Vinyl chloride	< 5.1	< 2.0	0.36 J	0.14 J	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		MW115											
		MW115			MW115			MW115			SG-MW115R		
		2/19/2007		3/20/2007		4/10/2007		7/17/2007		10/16/2007		1/7/2008	
Location: Sample ID: Sample Date: Units:		MW115		MW115		MW115		MW115		MW115-SG		MW115R-SG	
Method		ppbv		ppbv		ppbv		ppbv		ppbv		ppbv	
Volatile Organic Compounds (VOCs)		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³	
Carbon tetrachloride		< 5.3		< 0.53		< 0.53		< 0.53		< 0.53		< 0.53	
Chloroethane		< 13		< 1.3		< 1.3		< 1.3		0.63 J		< 0.53	
Chloroform		NT		NT		NT		NT		NT		NT	
1,1-Dichloroethane		< 8.1		0.65 J		< 0.81		< 0.81		< 0.81		< 0.81	
1,1-Dichloroethylene		< 7.9		< 0.79		< 0.79		< 0.79		< 0.79		< 0.79	
cis-1,2-Dichloroethylene		< 7.9		1.3		< 0.79		< 0.79		< 0.79		< 0.79	
trans-1,2-Dichloroethylene		< 11		< 1.1		< 1.1		< 1.1		< 1.1		< 0.79	
Tetrachloroethylene (PCE)		< 7.9		< 0.79		< 0.79		< 0.79		< 0.79		< 0.79	
1,1,1-Trichloroethane (TCA)		42		12		< 1.4		71.2		12		14	
Trichloroethylene (TCE)		15		< 1.1		< 0.20		0.75 J		1.0 J		2.0	
Vinyl chloride		< 5.1		< 2.0		< 0.20		< 0.20		< 0.20		< 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and the result is estimated.

Attachment C 3f
Risk Characterization Data - Soil Vapor
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location:			MW118S				MW121S				MW122				
Sample ID:			SG-MW118S		MW118S-SG		MW121S-SG		MW121S-SG		MW122-SG		MW122-SG		
Sample Date:			7/17/2007		8/30/2007		4/14/2008		10/22/2007		1/8/2008		1/30/2008		
Units:			µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	
Method															
Analyte	TO-15														
	Volatile Organic Compounds (VOCs)														
	Carbon tetrachloride	4.8	0.77	2.2	0.35	< 1.3	< 0.20	< 1.3	< 0.20	< 0.20	0.13 J	< 4.0	< 6.3	< 1.0	
	Chloroethane	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.20	< 0.20	< 4.0	< 2.6	< 1.0	
	Chloroform	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
	1,1-Dichloroethane	< 0.81	< 0.20	< 0.81	< 0.20	2.8	0.69	2.1	0.52	< 0.20	< 0.20	2.8 J	5.3	1.3	
	1,1-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	0.67 J	0.17 J	< 0.20	< 0.20	3.0 J	2.8 J	0.71 J	
	cis-1,2-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20	2.3 J	4.8	1.2	
	trans-1,2-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20	< 4.0	< 4.0	< 1.0	
	Tetrachloroethylene (PCE)	231	34.1	155	22.9	6.0	0.88	2.0	0.30	< 0.20	1.8	784	1340	197	
	1,1,1-Trichloroethane (TCA)	8.2	1.5	6	1.1	3.1	0.57	< 1.1	< 0.20	< 0.20	< 1.1	< 4.0	8.2	1.5	
	Trichloroethylene (TCE)	2.1	0.39	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	< 1.1	12.9	35	6.6	
	Vinyl chloride	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	1.8	0.72	< 0.20	< 0.51	< 4.0	< 2.6	< 1.0	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
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Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Location Name:		Garage							
		Sample Name:		50TUFTS-GA		50T-GA		50TUFTS-GA		50TUFTS-GA	
		Sample Date:		10/4/07		12/7/07		5/1/08		3/9/09	
		Units:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method		TO-15									
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride		< 1.3	< 0.20	0.63 J	0.10 J	< 1.3	< 0.20	< 1.3	< 0.20	< 0.20	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.20	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20
Tetrachloroethylene (PCE)		6.2	0.91	10	1.5	9.5	1.4	6.4	0.95	0.95	0.95
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	1.0 J	0.19 J	< 1.1	< 1.1	< 0.20	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	1.9	0.35	< 1.1	< 1.1	< 0.20	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	North Central Warehouse					
		50TUFTS-NC 10/4/07		50T-NC 12/7/07		50TUFTS-NC 5/1/08	
		ppbv		ppbv		ppbv	
		µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,1-Dichloroethane 1,1-Dichloroethylene cis-1,2-Dichloroethylene Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	TO-15	< 1.3	0.63 J	0.10 J	< 1.3	< 0.20	< 0.20
		< 0.81	< 0.81	< 0.20	< 0.81	< 0.20	< 0.20
		< 0.79	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20
		< 0.79	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20
		5.5	10	1.5	6.4	0.94	0.9
		< 1.1	< 1.1	< 0.20	0.98 J	0.18 J	< 0.20
		< 1.1	< 1.1	< 0.20	1.9	0.36	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			North Office							
Sample Name:			50T-NO 12/7/07		50TUFTS-NO 5/1/08		50TUFTS-NO 3/9/09			
Sample Date:			µg/m ³		ppbv		µg/m ³		ppbv	
Units:										
Analyte	Method									
TO-15										
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride			0.75 J		0.12 J		< 1.3		< 0.20	
1,1-Dichloroethane			< 0.81		< 0.20		< 0.81		< 0.20	
1,1-Dichloroethylene			< 0.79		< 0.20		< 0.79		< 0.20	
cis-1,2-Dichloroethylene			< 0.79		< 0.20		< 0.79		< 0.20	
Tetrachloroethylene (PCE)			12		1.8		4.3		0.64	
1,1,1-Trichloroethane (TCA)			< 1.1		< 0.20		0.65 J		0.12 J	
Trichloroethylene (TCE)			< 1.1		< 0.20		1.3		0.24	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4a

Risk Characterization Data - Indoor Air

Property Exposure Area

50 Tufts Street

Somerville, Massachusetts

North Warehouse

General Notes:

2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.

Qualifying Notes:

- is estimated.

Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:		South Central Warehouse									
			50TUFTS-SC1		50TUFTS-SC2		50TUFTS-SC3		50TUFTS-SC4		50TUFTS-SC	
			10/4/07		10/4/07		10/4/07		10/4/07		12/7/07	
			µg/m ³	µg/m ³	ppbv	ppbv	µg/m ³	µg/m ³	ppbv	ppbv	ppbv	µg/m ³
Volatile Organic Compounds (VOCs)	TO-15											
Carbon tetrachloride			< 1.3	< 0.20	< 1.3	< 0.20	0.60 J	0.096 J	< 1.3	< 0.20	< 0.20	< 1.3
1,1-Dichloroethane			< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.20	< 0.81
1,1-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.79
cis-1,2-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.79
Tetrachloroethylene (PCE)			6.0	0.88	5.9	0.87	5.7	0.84	5.4	0.8	1.6	10
1,1,1-Trichloroethane (TCA)			< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	< 1.1
Trichloroethylene (TCE)			< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	< 1.1

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:										
Sample Name:										
Sample Date:										
Units:										
Analyte	Method									
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,1-Dichloroethane 1,1-Dichloroethylene cis-1,2-Dichloroethylene Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	TO-15									
	50TUFTS-SC1		50TUFTS-SC2		50TUFTS-SC1		50TUFTS-SC2		50TUFTS-SC1	
	5/1/08		5/1/08		3/9/09		3/9/09		3/9/09	
	µg/m³		ppbv		µg/m³		ppbv		ppbv	
	µg/m³		ppbv		µg/m³		ppbv		ppbv	
	< 1.3		< 1.3		< 1.3		< 1.3		< 1.3	
	< 0.81		< 0.81		< 0.81		< 0.81		< 0.81	
	< 0.79		< 0.79		< 0.79		< 0.79		< 0.79	
	< 0.79		< 0.79		< 0.79		< 0.79		< 0.79	
	6.6		8.1		6.0		0.89		6.7	
0.93 J		0.98 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8		2.1		< 1.1		< 0.20		< 1.1		
0.34		0.39		< 1.1		< 0.20		< 1.1		
0.17 J		0.18 J		< 1.1		< 0.20		< 1.1		
0.98		1.2		6.0		0.89		6.7		
0.98 J		0.18 J		< 1.1		< 0.20		< 1.1		
1.8										

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4a
Risk Characterization Data - Indoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Location Name: Sample Name: Sample Date: Units:		South Office									
				50TUFTS-SO 10/4/07		50T-SO 12/7/07		50TUFTS-SO 5/1/08		50TUFTS-SO 3/9/09			
				µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv		
Volatile Organic Compounds (VOCs)		TO-15											
Carbon tetrachloride		< 1.3	< 0.20	0.62 J	0.098 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 0.20	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.20	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.20	< 0.20
Tetrachloroethylene (PCE)		5.5	0.81	11	1.6	4.8	0.71 J	2.4	0.71	2.4	0.36	0.36	0.36
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	0.71 J	0.13 J	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	1.5	0.28	< 1.1	< 0.20	< 1.1	< 0.20	< 0.20	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. The sub-slab depressurization system (SSDS) and soil vapor extraction (SVE) system began operating on April 30, 2007 and August 22, 2007, respectively.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- G The reported result is estimated due to duplicate precision outside control limits.
- J+ The reported result is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		60 Tufts, Unit 1							
		60TUFTU1-1 5/27/09		60TUFTU1-1 3/3/10		60TUFTU1-1 9/19/10		60TUFTU1-1 2/5/11	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	NT	NT	NT	NT
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	NT	NT	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	60 Tufts, Hall outside Unit 1			
	60TUFTHALL-A 4/20/10		60TUFTHALL-A 4/20/10	
	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	< 1.3	< 0.20	< 1.3	< 0.20
	< 0.81	< 0.20	< 0.81	< 0.20
	< 1.4	< 0.20	< 1.4	< 0.20
	< 1.1	< 0.20	< 1.1	< 0.20
	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample a complete list of analytes see the attached.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a co specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		60 Tufts Street, Unit 4							
		60TUFTU4-1 5/27/09		60TUFTU4-B 5/27/09		60TUFTU4-1 6/22/09		60TUFTU4-B 6/22/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane		3.2	0.80	< 0.81	< 0.20	2.8	0.70	< 0.81	< 0.20
Tetrachloroethylene (PCE)		1.4	0.20	1.0 J	0.15 J	0.95 J	0.14 J	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	0.75 J	0.14 J

General Notes:

1. Analytes detected in at least one sample a complete list of analytes see the attached.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a co specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory is estimated.

Attachment C 4b
 Risk Characterization Data - Indoor Air
 60 Tufts Street Exposure Area
 50 Tufts Street
 Somerville, Massachusetts

Analyte	60 Tufts Street, Unit 4							
	60TUFTU4-1 2/24/10		60TUFTU4-B 2/24/10		60TUFTU4-1 9/19/10		60TUFTU4-B 9/19/10	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA) Trichloroethylene (TCE)	< 1.3	< 0.20	< 1.3	< 0.20	NT	NT	NT	NT
	< 0.81	< 0.20	< 0.81	< 0.20	NT	NT	NT	NT
	5.8	0.86	5.2	0.76	< 1.4	< 0.20	< 1.4	< 0.20
	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
	2.1	0.39	1.9	0.35	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample a complete list of analytes see the attached.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

		60 Tufts Street, Unit 4			
		60TUFTU4-1 2/5/11		60TUFTU4-B 2/5/11	
Analyte		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)					
Carbon tetrachloride		NT	NT	NT	NT
1,2-Dichloroethane		NT	NT	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are listed in a complete list of analytes see the attached report.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration below the specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

		60 Tufts Street, Unit 5							
Analyte		60TUFTU5-1 5/27/09		60TUFTU5-1 2/24/10		60TUFTU5-1 4/20/10		60TUFTU5-1 9/21/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		< 1.3 < 0.81 < 1.4 < 1.1 < 1.1	< 0.20 < 0.20 < 0.20 < 0.20 < 0.20	< 1.3 < 0.81 49 < 1.1 17	< 0.20 < 0.20 7.2 < 0.20 3.2	< 1.3 < 0.81 < 1.4 < 1.1 < 1.1	< 0.20 < 0.20 < 0.20 < 0.20 < 0.20	NT NT < 1.4 < 1.1 < 1.1	NT NT < 0.20 < 0.20 < 0.20

General Notes:

1. Analytes detected in at least one sample a complete list of analytes see the attached.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a co specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory is estimated.

Attachment C 4b
Risk Characterization Data - Indoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	60 Tufts, Unit 10		60 Tufts, Unit 16	
	60TUFTU10-1 5/27/09		60TUFTU16-1 6/5/09	
	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
Volatile Organic Compounds (VOCs)				
Carbon tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane	< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)	1.0 J	0.15 J	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample a complete list of analytes see the attached.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a co specified laboratory reporting limit.
5. NT = not tested.

Qualifying Note:

J The reported result is below the laboratory is estimated.

Attachment C 4c
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
9 Tufts Street
Somerville, Massachusetts

9 Tufts Street												
Location Name:			IA-5 (1) 2/23/05 Shaw		IA-6 (B) 2/23/05 Shaw		9TUFTS-1L 3/23/06 GEI		9TUFTS-1R 3/23/06 GEI		9TUFTS-BR 3/23/06 GEI	
Sample Name:			µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³	
Sample Date:			ppbv		ppbv		ppbv		ppbv		ppbv	
Collected By:												
Units:												
Method												
Analyte	TO-15											
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride	< 1.3											
Chloroform	1.2											
Chloromethane	1.0											
1,2-Dichloroethane	< 0.81											
Methylene chloride	0.59 J											
Tetrachloroethylene (PCE)	1.8											
	< 0.20											
	0.25											
	0.49											
	< 0.20											
	0.17 J											
	0.27											
	< 1.3											
	0.54 J											
	0.91											
	< 0.81											
	0.56 J											
	1.3 J											
	< 0.20											
	0.11 J											
	0.44											
	< 0.20											
	0.16 J											
	0.19 J											
	< 1.3											
	0.78 J											
	1.4 G											
	< 0.81											
	1.8 B											
	< 1.4											
	< 0.20											
	0.16 J											
	0.69 G											
	< 0.20											
	1.3 B											
	0.95 J											
	< 0.20											
	< 0.20											
	< 0.20											
	0.69 G											
	< 0.20											
	1.9 B											
	2.4											
	< 0.20											
	0.26											
	0.53 G											
	< 0.20											
	0.36 B											
	0.14 J											
	0.55 B											
	0.35											

Attachment C 4c
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
9 Tufts Street
Somerville, Massachusetts

Location Name:		9 Tufts Street (continued)							
Sample Name:		9TUFTS-1L		9TUFTS-1R		9TUFTS-BR		9TUFTS-1L	
Sample Date:		7/24/06		7/24/06		7/24/06		10/2/06	
Collected By:		GEI		GEI		GEI		GEI	
Units:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs)	TO-15								
		Carbon tetrachloride		< 0.20		< 1.3		< 0.20	
		Chloroform		0.18 J		2.3		0.47	
		Chloromethane		0.49		1.1		0.55	
		1,2-Dichloroethane		< 0.20		< 0.81		< 0.20	
		Methylene chloride		1.2 B		6.6 B		1.9 B	
Tetrachloroethylene (PCE)		1.2 J		0.18 J		2.0		0.29	
				< 1.3		< 1.3		< 0.20	
		0.88 J		0.18 J		2.3		0.24	
		1.0		0.49		1.1		0.46	
		< 0.81		< 0.20		< 0.81		< 0.20	
		4.2 B		1.2 B		6.6 B		11 B	
		1.2 J		0.18 J		2.0		3.1	
				< 0.20		< 1.3		< 0.20	
				0.18 J		1.2		NT	
				0.49		0.95		NT	
				< 0.20		< 0.81		< 0.20	
				1.2 B		11 B		NT	
				0.18 J		3.1		0.52	
				0.29		0.45			

Attachment C 4c
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
9 Tufts Street
Somerville, Massachusetts

9 Tufts Street (continued)												
Analyte	Location Name:		9 TUFTS-1R		9 TUFTS-BR		9 TUFTS-1L		9 TUFTS-1R		9 TUFTS-BR	
	Sample Name:		10/2/06		10/2/06		12/15/06		12/15/06		12/15/06	
	Sample Date:		GEI		GEI		GEI		GEI		GEI	
	Collected By:		ppbv		ppbv		ppbv		ppbv		ppbv	
	Units:		µg/m ³		µg/m ³		µg/m ³		µg/m ³		µg/m ³	
Method												
TO-15												
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.62 J	0.099 J	0.59 J	0.093 J	0.75 J	0.12 J	
Chloroform		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
Chloromethane		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	
Methylene chloride		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
Tetrachloroethylene (PCE)		6.2	0.91	16	2.4	1.9	0.28	0.64 J	0.095 J	2.2	0.32	

Attachment C 4d
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
11-13 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		11-13 Tufts Street					
		IA-2 (B) 2/23/05 Shaw		IA-2D (Duplicate) 2/23/05 Shaw		IA-1 (1) 2/23/05 SHAW	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:					
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		< 0.98	< 0.20	< 0.98	< 0.20	2.8	0.57
		0.81	0.39	0.74	0.36	0.99	0.48
		1.0	0.29	0.90	0.26	0.8	0.23
		1.8	0.26	1.9	0.28	1.0 J	0.15 J
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

Attachment C 4d
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
11-13 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By: Units:		11-13 Tufts Street (continued)					
		11/13TUFTS-1 3/24/06 GEI		11/13TUFTS-B 3/24/06 GEI		11/13 TUFTS-1 6/29/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.69 J	0.11 J
Chloroform		< 0.98	< 0.20	< 0.98	< 0.20	< 0.98	< 0.20
Chloromethane		1.4 G	0.70 G	1.4 G	0.68 G	1.7	0.80
Methylene chloride		1.2 J+	0.34 J+	4.5 J+	1.3 J+	2.7 J+	1.5 J+
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	1.8	0.36
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	0.71 J	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4d
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
11-13 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By:		11-13 Tufts Street (continued)					
		11/13 TUFTS-1 9/28/06 GEI		11/13 TUFTS-B 9/28/06 GEI		11/13 TUFTS-1 12/15/06 GEI	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:					
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.62 J	0.11 J
Chloroform		NT	NT	NT	NT	NT	NT
Chloromethane		NT	NT	NT	NT	NT	NT
Methylene chloride		NT	NT	NT	NT	NT	NT
Tetrachloroethylene (PCE)		1.5	0.22	0.88 J	0.13 J	2.2	0.33
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4e
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
17 Tufts Street
Somerville, Massachusetts

Analyte		17 Tufts Street					
		Sample Location:		17TUFTS-1		17TUFTS-B	
		Sample Name:	Sample Date:	IA-11 (B)	3/24/06	3/24/06	GEI
		Collected By:	Shaw	Shaw	GEI	GEI	
		Units:	µg/m ³	ppbv	µg/m ³	ppbv	ppbv
		Method					
Volatile Organic Compounds (VOCs)		TO-15					
Carbon tetrachloride			NT	NT	< 1.3	< 0.20	< 0.20
Chloroform			1.9	0.39	< 0.98	< 0.20	< 0.20
Chloromethane			1.1	0.52	1.7 G	0.80 G	0.58 G
Methylene chloride			1.0	0.3	4.2 J+	1.2 J+	17.0 G
Tetrachloroethylene (PCE)			4.7	0.69	2.9	0.43	0.19 J
Trichloroethylene (TCE)			< 1.1	< 0.20	< 1.1	< 0.20	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "L" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. C = Duplicate of Basement (B) samples.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4e
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
17 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Collected By: Units:		17 Tufts Street (continued)							
		17TUFTS-C (FD of B)		17TUFTS-1		17TUFTS-B		17TUFTS-C (FD of B)	
		3/24/06		10/2/06		10/2/06		10/2/06	
		GEI		GEI		GEI		GEI	
Analyte	Method	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		< 0.98	< 0.20	NT	NT	NT	NT	NT	NT
		1.4 G	0.69 G	NT	NT	NT	NT	NT	NT
		57.3 G	16.5 G	NT	NT	NT	NT	NT	NT
		1.4	0.21	0.88 J	0.13 J	6.1	0.90	6.0	0.89
		0.70 J	0.13 J	< 1.1	< 0.20	7.0	1.3	7.0	1.3

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. C = Duplicate of Basement (B) samples.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4e
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
17 Tufts Street
Somerville, Massachusetts

Analyte		17 Tufts Street (continued)					
		Sample Location:		17 TUFTS-1 12/18/06 GEI		17 TUFTS-B 12/18/06 GEI	
		Sample Name:	Sample Date:	Collected By:	Units:		
Method							
TO-15							
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride							
Chloroform							
Chloromethane							
Methylene chloride							
Tetrachloroethylene (PCE)							
Trichloroethylene (TCE)							
		0.57 J NT NT NT 1.5 < 1.1	0.090 J NT NT NT 0.22 < 0.20	0.52 J NT NT NT 2.0 0.70 J	0.083 J NT NT NT 0.30 0.13 J	< 1.3 NT NT NT < 1.4 < 1.1	< 0.20 NT NT NT < 0.20 < 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "Z" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. C = Duplicate of Basement (B) samples.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4f
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
19 Tufts Street
Somerville, Massachusetts

Sample Location:		19 Tufts Street									
Sample Name:		IA-14 (1) 3/24/05 Shaw		IA-13 (B) 3/24/05 Shaw		19TUFTS-1 3/23/06 GEI		19TUFTS-B 3/23/06 GEI		19TUFTS-C 3/23/06 GEI	
Sample Date:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Collected By:											
Units:											
Analyte	Method										
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15	< 1.3 0.78 J 1.1 0.34 J 0.95 J < 1.1	< 0.20 0.16 J 0.52 0.099 J 0.14 J < 0.20	< 1.3 < 0.98 0.85 0.35 J 3.2 < 1.1	< 0.20 < 0.20 0.41 0.1 J 0.47 < 0.20	< 1.3 < 0.98 21.7 G 4.2 J+ 1.2 < 1.1	< 0.20 < 0.20 10.5 G 1.2 J+ 0.18 < 0.20	< 1.3 < 0.98 1.8 G 3.2 J+ 7.5 < 1.1	< 0.20 < 0.20 0.88 G 0.92 J+ 1.1 < 0.20	< 1.3 < 0.98 1.8 G 4.2 J+ 6.6 < 1.1	< 0.20 < 0.20 0.85 G 1.2 J+ 0.98 < 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. C = Duplicate of Basement (B) samples.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4f
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
19 Tufts Street
Somerville, Massachusetts

19 Tufts Street (continued)										
Sample Location: Sample Name: Sample Date: Collected By: Units:	19 TUFTS-1 6/29/06 GEI		19 TUFTS-B 6/29/06 GEI		19 TUFTS-C 6/29/06 GEI		19TUFTS-1 10/10/06 GEI		19TUFTS-B 10/10/06 GEI	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method									
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15									
	0.69 J	0.11 J	0.69 J	0.11 J	0.69 J	0.11 J	< 1.3	< 0.20	< 1.3	< 0.20
	5.4	1.1	0.83 J	0.17 J	0.88 J	0.18 J	NT	NT	NT	NT
	2.3	1.1	3.1	1.5	< 0.41	< 0.20	NT	NT	NT	NT
	14 J+	4.1 J+	14 J+	4.0 J+	13 J+	3.6 J+	NT	NT	NT	NT
	2.4	0.35	4.1	0.60	3.8	0.56	< 1.4	< 0.20	15	2.2
	1.7	0.31	2.1	0.39	1.6	0.30	< 1.1	< 0.20	6.4	1.2

Attachment C 4f
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
19 Tufts Street
Somerville, Massachusetts

19 Tufts Street (continued)												
Sample Location:			19TUFTS-C 10/10/06 GEI		19 TUFTS-1 12/15/06 GEI		19 TUFTS-B 12/15/06 GEI		19 TUFTS-C 12/15/06 GEI			
Sample Name: Sample Date: Collected By: Units:			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv		
Analyte	Method											
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroform Chloromethane Methylene chloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15											
			< 1.3 NT NT NT 6.8 6.4	< 0.20 NT NT NT 1.0 1.2	0.63 J NT NT NT 0.60 J < 1.1		0.10 J NT NT NT 0.089 J < 0.20		0.59 J NT NT NT 2.5 < 1.1		0.093 J NT NT NT 0.37 < 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. C = Duplicate of Basement (B) samples.
7. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4g
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
23 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		23 Tufts Street post-SSDS							
		23TUFTS-1 5/26/07		23TUFTS-B 5/26/07		23TUFTS-1 11/17/07		23TUFTS-B 11/17/07	
Analyte	Method	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.75 J	0.12 J	0.69 J	0.11 J
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	0.26 J	0.064 J
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		0.51 J	0.093 J	0.54 J	0.099 J	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. SSDS = Sub-Slab Depressurization System.
5. Field duplicate samples were collected in January 2009 from the first floor (-1A and -1B) and basement (-B1 and -B2).

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4g
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
23 Tufts Street
Somerville, Massachusetts

Analyte		23 Tufts Street post-SSDS (continued)							
		Sample Location:		23TUFTS-1		23TUFTS-B		23TUFTS-1A	
		Sample Name:	Sample Date:	2/1/08	ppbv	2/1/08	ppbv	1/14/09	ppbv
Units:				µg/m ³		µg/m ³		µg/m ³	ppbv
Method									
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride									
1,2-Dichloroethane									
Tetrachloroethylene (PCE)									
1,1,1-Trichloroethane (TCA)									
				0.59 J	0.094 J	< 1.3	< 0.20	0.88 J	0.14 J
				< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
				< 1.4	< 0.20	< 1.4	< 0.20	0.62 J	0.091 J
				< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. SSDS = Sub-Slab Depressurization System.
5. Field duplicate samples were collected in January 2009 from the first floor (-1A and -1B) and basement (-B1 and -B2).

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4g
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
23 Tufts Street
Somerville, Massachusetts

Analyte		Sample Location: Sample Name: Sample Date: Units:		23 Tufts Street post-SSDS (continued)							
				23TUFTS-B1 1/14/09		23TUFTS-B2 1/14/09		23TUFTS-1 2/25/10		23TUFTS-B 2/25/10	
				µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		TO-15									
Carbon tetrachloride				0.82 J	0.13 J	0.75 J	0.12 J	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane				< 0.81	< 0.20	< 0.81	< 0.20	2.1	0.53	< 0.81	< 0.20
Tetrachloroethylene (PCE)				1.4	0.20	1.3 J	0.19 J	1.5	0.22	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)				< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. SSDS = Sub-Slab Depressurization System.
5. Field duplicate samples were collected in January 2009 from the first floor (-1A and -1B) and basement (-B1 and -B2).

Qualifying Note:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4h
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
25 Tufts Street
Somerville, Massachusetts

Sample Location:		25 Tufts Street					
Sample Name:		IA-3 (1) 2/23/05 Shaw		IA-4 (B) 2/23/05 Shaw		25TUFTS-1 3/23/06 GEI	
Sample Date:							
Collected By:							
Units:							
Analyte	Method						
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride	TO-15						
Chloroform							
Chloromethane							
Methylene chloride							
Tetrachloroethylene (PCE)							
		$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv
		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		2	0.4	< 0.98	< 0.20	< 0.98	< 0.20
		0.95	0.46	0.74	0.36	1.1 G	0.52 G
		< 1.4 J+	< 0.20 J+	0.49 J	0.14 J	1.6 J+	0.47 J+
		< 1.1	< 0.20	1.6	0.23	3.2	0.47

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4h
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
25 Tufts Street
Somerville, Massachusetts

25 Tufts Street (continued)						
Sample Location:		25TUFTS-1		25TUFTS-B		25TUFTS-B
Sample Name:		8/1/06		8/1/06		10/2/06
Sample Date:		GEI		GEI		GEI
Collected By:		ppbv		ppbv		ppbv
Units:		μg/m ³		μg/m ³		μg/m ³
Method		ppbv		ppbv		ppbv
Analyte	Method	μg/m ³		μg/m ³		μg/m ³
Volatile Organic Compounds (VOCs)	TO-15	μg/m ³		μg/m ³		μg/m ³
	Carbon tetrachloride	ppbv		ppbv		ppbv
	Chloroform	ppbv		ppbv		ppbv
	Chloromethane	ppbv		ppbv		ppbv
	Methylene chloride	ppbv		ppbv		ppbv
Tetrachloroethylene (PCE)	TO-15	ppbv		ppbv		ppbv

Attachment C 4h
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
25 Tufts Street
Somerville, Massachusetts

Sample Location:			25 Tufts Street (continued)		
Sample Name: Sample Date: Collected By:			25 TUFTS-1 12/15/06 GEI	25 TUFTS-B 12/15/06 GEI	
Analyte	Method	Units:	µg/m ³	ppbv	ppbv
Volatile Organic Compounds (VOCs)	TO-15				
Carbon tetrachloride			0.63 J	0.10 J	0.089 J
Chloroform			NT	NT	NT
Chloromethane			NT	NT	NT
Methylene chloride			NT	NT	NT
Tetrachloroethylene (PCE)			1.7	0.25	0.97

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not Tested.
6. Samples from 2005 were collected by Shaw Environmental, Inc.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4i
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
27 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		Post-EPEM 27 Tufts Street							
		27TUFT-1 2/25/09		27 TUFT-B 2/25/09		27TUFT-1 3/4/09		27 TUFT-B 3/4/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Tetrachloroethylene (PCE)	TO-15								
		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20

Attachment C 4i
Risk Characterization Data - Indoor Air
Tufts Street and MBTA Railroad Area Exposure Area
27 Tufts Street
Somerville, Massachusetts

Sample Location:		Post-EPEM 27 Tufts Street (continued)			
		27TUFT-1 8/25/09		27 TUFT-B 8/25/09	
Analyte	Units:	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Tetrachloroethylene (PCE)	Method TO-15	1.3 J	0.19 J	1.8	0.26

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not tested.
6. Samples ending with -1 and -1(2), -B and -B(2), -1A and -1B, and -B1 and -B2 are field duplicates of each other.
7. Samples from 2005 were collected by Shaw Environmental, Inc.
8. * = Improper duplicate precision, this sampling was repeated on September 26, 2008.
9. The samples collected in August 2009 were collected over a 24-hour period from August 24 to 25, 2009.
10. EPEM = Exposure Pathway Elimination System.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 4j
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
91-93 Franklin Street
Somerville, Massachusetts

91-93 Franklin Street - All analytes non-detect on 4/8/09, 3/24/10, 12/7/10, and 2/2/11.

Attachment C 4k
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
95 Franklin Street
Somerville, Massachusetts

Sample Location:		95 Franklin Street with active EPEM (SSDS)				95 Franklin Street with passive EPEM			
Sample Name:		95FRAN-1		95FRAN-B1		95 FRAN-1		95 FRAN-B	
Sample Date:		6/7/07		6/7/07		1/6/11		1/6/11	
Units:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE) Trichloroethylene (TCE)	TO-15	0.63 J		0.69 J		NT		NT	
		8.8		8.1		14		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.10 J		0.11 J		NT		NT	
		1.30		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		0.17 J	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	
		8.1		8.1		29		29	
		< 1.1		< 1.1		< 1.1		0.91 J	
		0.11 J		0.11 J		NT		NT	
		1.2		1.2		2.1		4.3	
		< 0.20		< 0.20		< 0.20		< 0.20	
		0.69 J		0.69 J		NT		NT	

Attachment C 4I

Risk Characterization Data - Indoor Air

Other Streets Area Exposure Area

95R Franklin Street

Somerville, Massachusetts

Analyte	Sample Location:		95R Franklin Street					
	Sample Name:		95R FRANK-B2		95RFRANK-1		95R Fran-1A	
	Sample Date:		11/15/07		11/15/07		12/23/07	
	Units:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	Method		TO-15					
	Carbon tetrachloride		0.63 J	0.10 J	0.61 J	0.097 J	0.58 J	0.092 J
	1,2-Dichloroethane (DCA)		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
	Tetrachloroethylene (PCE)		1.3 J	0.19 J	1.3 J	0.19 J	1.0 J	0.15 J
1,1,1-Trichloroethane (TCA)			< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
	Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4I
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
95R Franklin Street
Somerville, Massachusetts

Analyte		95R Franklin Street (continued)					
		Sample Location:		95R Frank-1		95R Frank-B	
		Sample Name:	Sample Date:	12/28/07	12/28/07	12/28/07	4/3/09
Units:				µg/m ³	ppbv	µg/m ³	ppbv
Method						µg/m ³	ppbv
TO-15						µg/m ³	ppbv
Volatile Organic Compounds (VOCs)						µg/m ³	ppbv
Carbon tetrachloride						µg/m ³	ppbv
1,2-Dichloroethane (DCA)						µg/m ³	ppbv
Tetrachloroethylene (PCE)						µg/m ³	ppbv
1,1,1-Trichloroethane (TCA)						µg/m ³	ppbv
Trichloroethylene (TCE)						µg/m ³	ppbv

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4I
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 95R Franklin Street
 Somerville, Massachusetts

Sample Location: 95R Franklin Street (continued)		
Sample Name: Sample Date:		95RFRANK-B 3/9/10
Analyte	Units:	ppbv
Volatile Organic Compounds (VOCs)	Method TO-15	
Carbon tetrachloride		
1,2-Dichloroethane (DCA)		
Tetrachloroethylene (PCE)		
1,1,1-Trichloroethane (TCA)		
Trichloroethylene (TCE)		

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4m
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
97 Franklin Street
Somerville, Massachusetts

97 Franklin Street									
Sample Location:		97FRAN-1		97FRAN-B		97FRAN-1		97FRAN-B	
Sample Name:		9/29/07		9/29/07		2/21/08		2/21/08	
Sample Date:		9/29/07		9/29/07		2/21/08		2/21/08	
Units:		ppbv		ppbv		ppbv		ppbv	
Method		µg/m³		µg/m³		µg/m³		µg/m³	
Analyte									
Volatile Organic Compounds (VOCs)	Carbon Tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
	Dichloroethane, 1,2-	< 0.81	< 0.20	< 0.81	< 0.20	0.69 J	0.17 J	< 0.81	< 0.20
	Tetrachloroethylene (PCE)	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	1.0 J	0.15 J

Attachment C 4m
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
97 Franklin Street
Somerville, Massachusetts

Analyte		97 Franklin Street (continued)							
		Sample Location:		97FRAN-1		97FRAN-B		97FRAN-1	
		Sample Name:		7/24/08		7/24/08		1/14/09	
		Sample Date:		ppbv		ppbv		ppbv	
		Units:		µg/m ³		µg/m ³		µg/m ³	
		Method							
Volatile Organic Compounds (VOCs)		TO-15							
Carbon Tetrachloride				0.69 J		0.69 J		0.63 J	
Dichloroethane, 1,2-				11		0.81		< 0.81	
Tetrachloroethylene (PCE)				< 1.4		1.3 J		< 1.4	
				0.11 J		0.11 J		0.10 J	
				2.6		0.20		< 0.20	
				< 0.20		0.19 J		< 0.20	
								0.75 J	
								< 0.81	
								0.81 J	
								0.12 J	
								< 0.20	
								0.12 J	

General Notes

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4m
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
97 Franklin Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date:		97 Franklin Street (continued)			
		97FRAN-1 3/8/10		97FRAN-B 3/8/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:			
Volatile Organic Compounds (VOCs)	TO-15				
Carbon Tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)		1.0 J	0.15 J	1.6	0.23

General Notes

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4n
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 99 Franklin Street
 Somerville, Massachusetts

Analyte		99 Franklin Street							
		Sample Location:							
		Sample Name:							
		Sample Date:							
Units:		99FRANK-B		99FRANK-1		99FRANK-B		99-FRANK-B	
		6/25/07		2/5/08		2/5/08		9/18/09	
		μg/m ³		ppbv		μg/m ³		ppbv	
		1.4		0.21		1.2 J		0.17 J	

Attachment C 4o
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
162-164 Glen Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		162-164 Glen Street							
		162GLEN-1 8/13/07		162GLEN-B 8/13/07		162GLEN-1 1/28/10		162GLEN-B 1/28/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	TO-15	0.63 J	0.10 J	0.69 J	0.11 J	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane		0.65 J	0.16 J	2.5	0.61	< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)		2.8	0.41	3.7	0.54	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		0.53 J	0.097 J	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4o
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
162-164 Glen Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date:		162-164 Glen Street					
		162-164-GLEN-1 11/19/10		162-164-GLEN-B 11/19/10		162-164-GLEN-1 2/4/11	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:					
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	NT	NT
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4p
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
163 Glen Street
Somerville, Massachusetts

Analyte		Sample Location: Sample Name: Sample Date: Units:		163 Glen Street			
				163GLEN-1A 11/5/07		163GLEN-1B 11/5/07	
				µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		TO-15					
Carbon tetrachloride				< 1.3	< 0.20	< 1.3	< 0.20
Tetrachloroethylene (PCE)				1.3 J	0.19 J	1.5	0.22
1,1,1-Trichloroethane (TCA)				0.87 J	0.16 J	0.93 J	0.17 J
						0.59 J	0.094 J
						< 1.4	< 0.2
						< 1.1	< 0.2

General Notes:

1. Analytes detected in at least one sample are reported here.
For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbV = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4p
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 163 Glen Street
 Somerville, Massachusetts

163 Glen Street (continued)									
Sample Location: Sample Name: Sample Date: Units:		163GLEN-1A 6/4/08		163GLEN-1B 6/4/08		163GLEN-1A 1/13/09		163GLEN-1B 1/13/09	
		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	0.63 J	0.10 J	0.62 J	0.098 J
		4.0	0.59	3.4	0.50	0.95 J	0.14 J	0.81 J	0.12 J
		0.82 J	0.15 J	0.87 J	0.16 J	0.71 J	0.13 J	0.76 J	0.14 J

Attachment C 4q
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
166-168 Glen Street
Somerville, Massachusetts

166-168 Glen Street - All analytes non-detect on 11/30/10 and 2/5/11.

Attachment C 4r
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
9 Knowlton Street
Somerville, Massachusetts

9 Knowlton Street - No indoor air samples collected after the Exposure Pathway Elimination System (EPEM) installation.

Attachment C 4s

Risk Characterization Data - Indoor Air

Other Streets Area Exposure Area

12-14 Knowlton Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		12-14 Knowlton Street							
		12-14KNOW1 6/14/07		12-14KNOWB 6/14/07		12-14KNOW-1 11/13/07		12-14KNOW-B 11/13/07	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane Tetrachloroethylene (PCE)	TO-15	< 1.3	< 0.20	0.62 J	0.099 J	0.63 J	0.10 J	0.63 J	0.10 J
		< 0.81	< 0.20	0.40 J	0.099 J	< 0.81	< 0.20	0.40 J	0.10 J
		< 1.4	< 0.20	1.0 J G	0.15 J G	< 1.4	< 0.20	2.0	0.29

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbV = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- G** The report is estimated due to duplicate precision outside control limits.
- J** The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4s

Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
12-14 Knowlton Street
Somerville, Massachusetts

Analyte		Sample Location: Sample Name: Sample Date: Units:		12-14 Knowlton Street (continued)							
				12-14KNOW-1		12-14KNOW-B		14KNOW-1		14KNOW-B	
				8/4/08		8/4/08		1/19/09		1/19/09	
				µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		TO-15		0.69 J	0.11 J	0.82 J	0.13 J	0.62 J	0.098 J	0.63 J	0.10 J
Carbon tetrachloride				1.6	0.39	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane				< 1.4	< 0.20	< 1.4	< 0.20	1.2 J	0.17 J	1.2 J	0.18 J
Tetrachloroethylene (PCE)											

General Notes:

1. Analytes detected in at least one sample are reported here.
For a complete list of analytes see the laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbV = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- G The report is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4t
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
13 Knowlton Street
Somerville, Massachusetts

Analyte		13 Knowlton Street Post-EPEM					
		Sample Location:		13KNOW-1		13KNOW-B	
		Sample Name:	Sample Date:	3/3/10	3/3/10	2/1/11	2/1/11
Volatile Organic Compounds (VOCs)		Units:		µg/m ³	ppbv	µg/m ³	ppbv
1,2-Dichloroethane		Method		TO-15			
				3.6	0.89	< 0.81	< 0.20
						NT	NT
						NT	NT

- General Notes:**
- Analytes detected in at least one sample are reported here.
For a complete list of analytes see the laboratory data sheets.
 - µg/m³ = micrograms per cubic meter.
 - ppbV = parts per billion by volume.
 - "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
 - EPEM = Exposure Pathway Elimination Measure.
 - The samples collected in March 2010 were collected over a 24-hour period from March 3 through 4, 2010.
 - Samples collected in February 2011 were collected over a 24-hour period from January 31, 2011 to February 1, 2011.

Qualifying Note:
J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4u
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
17 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		17 Knowlton Street post-EPEM										
		17KNOW-1 5/13/09		17KNOW-B 5/13/09		17KNOW-1 6/5/09		17KNOW-B 6/5/09		17KNOW-B 11/19/10		
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	
Analyte	Method											
Volatile Organic Compounds (VOCs) 1,2-Dichloroethane (DCA) Tetrachloroethylene (PCE)	TO-15											
		0.81	0.20	< 0.81	< 0.20	0.93	0.23	< 0.81	< 0.20	< 0.81	< 0.20	
		1.6	0.23	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	

Attachment C 4v
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
23 Knowlton Street
Somerville, Massachusetts

Sample Location:		23 Knowlton Street					
Sample Name: Sample Date:		23 KNOW-1 4/23/07		23 KNOW-B 4/23/07		23KNOW-1 11/7/07	
Units:		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		1.0 J	0.16 J	< 1.3	< 0.20	0.69 J	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	0.38 J	0.089 J
Tetrachloroethylene (PCE)		1.3 J	0.19 J	1.2 J	0.18 J	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	0.87 J	0.16 J	< 1.1	0.11 J
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4v

Risk Characterization Data - Indoor Air

Other Streets Area Exposure Area

23 Knowlton Street

Somerville, Massachusetts

Sample Location:		23 Knowlton Street (continued)							
Sample Name:		23KNOW-1 2/5/08		23KNOW-B 2/5/08		23KNOW-1 6/20/08		23KNOW-B 6/20/08	
Sample Date:									
Units:		µg/m³		ppbv		µg/m³		ppbv	
Method									
Volatile Organic Compounds (VOCs)	TO-15								
	Carbon tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20	1.3	0.20	0.69 J	0.11 J
	1,2-Dichloroethane	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
	Tetrachloroethylene (PCE)	< 1.4	< 0.20	8.8	1.3	< 1.4	< 0.20	< 1.4	< 0.20
	1,1,1-Trichloroethane (TCA)	< 1.1	< 0.20	0.35 J	0.064 J	0.55 J	0.10 J	1.4	0.25
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4v
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
23 Knowlton Street
Somerville, Massachusetts

Analyte		23 Knowlton Street (continued)					
		Sample Location:		23KNOW-1		23KNOW-B	
		Sample Name:	Sample Date:	1/15/09	8/10/09	1/15/09	8/10/09
Units:		Method		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		TO-15		µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride				0.82 J	0.13 J	0.63 J	0.10 J
1,2-Dichloroethane				< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)				1.3 J	0.19 J	4.5	0.66
1,1,1-Trichloroethane (TCA)				< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)				< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4w
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
31-33 Knowlton Street
Somerville, Massachusetts

Analyte	Sample Location: Sample Name: Sample Date: Units:	31-33 Knowlton Street post-EPEM							
		31KNOW1 8/6/2007		31KNOWB 8/6/2007		31KNOW-1 11/12/2007		31KNOW-B 11/12/2007	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		Method							
Volatile Organic Compounds (VOCs)		TO-15							
Carbon tetrachloride			< 1.3	< 0.20	< 0.69 J	< 0.11 J	< 1.3	0.62 J	0.099 J
Tetrachloroethylene (PCE)			< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 1.4	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4w
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
31-33 Knowlton Street
Somerville, Massachusetts

Analyte		31-33 Knowlton Street post-EPEM (continued)											
		Sample Location:		31-33KNOW-1		31-33KNOW-B		31-33KNOW-B					
		Sample Name:		2/6/2008		2/6/2008		7/14/2008					
		Sample Date:		2/6/2008		2/6/2008		7/14/2008					
Units:		µg/m ³		ppbv		µg/m ³		ppbv		µg/m ³		ppbv	
Method													
Volatile Organic Compounds (VOCs)		TO-15											
Carbon tetrachloride				< 1.3		< 0.20		< 1.3		< 0.20		< 0.20	
Tetrachloroethylene (PCE)				1.9		0.28		4.9		0.72		< 1.4	

Attachment C 4w
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
31-33 Knowlton Street
Somerville, Massachusetts

Analyte		31-33 Knowlton Street post-EPEM (continued)															
		Sample Location:		31-33KNOW-1A		31-33KNOW-1B		31-33KNOW-B1		31-33KNOW-B2							
		Sample Name:		1/19/09		1/19/09		1/19/09		1/19/09							
		Sample Date:		1/19/09		1/19/09		1/19/09		1/19/09							
Units:		µg/m ³		ppbv		µg/m ³		ppbv		µg/m ³		ppbv					
Method																	
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)		TO-15		< 1.3		< 0.20		< 1.3		0.62 J		0.099 J		0.59 J		0.094 J	
				< 1.4		< 0.20		< 1.4		1.2 J		0.17 J		1.1 J		0.16 J	

Attachment C 4w
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
31-33 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		31-33 Knowlton Street post-EPEM (continued)			
		31KNOW-1 3/19/10		31KNOW-B 3/19/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method				
Volatile Organic Compounds (VOCs)	TO-15				
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20

General Notes:

- Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
- µg/m³ = micrograms per cubic meter.
- ppbv = parts per billion by volume.
- "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
- EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4x
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
32 Knowlton Street
Somerville, Massachusetts

32 Knowlton Street post-EPEM						
Location Name: Sample Name: Sample Date: Units:	Method	32KNOW-1 7/30/09		32KNOW-B 7/30/09		32KNOW-1 1/28/10
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³
		ppbv		ppbv		ppbv
		µg/m ³		µg/m ³		µg/m ³
Analyte	Volatile Organic Compounds (VOCs) 1,2-Dichloroethane	TO-15		TO-15		TO-15
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81
		< 0.81	< 0.20	3.0	0.73	< 0.81

Attachment C 4x
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 32 Knowlton Street
 Somerville, Massachusetts

Location Name:		32 Knowlton Street post-EPEM (continued)			
Sample Name:		32KNOW-1		32KNOW-B	
Sample Date:		11/19/10		11/19/10	
Units:		µg/m ³		ppbv	
Method		ppbv		µg/m ³	
TO-15		NT		NT	
Volatile Organic Compounds (VOCs)		NT		NT	
1,2-Dichloroethane		NT		NT	

Attachment C 4y
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
35-37 Knowlton Street
Somerville, Massachusetts

Analyte	Sample Location: Sample Name: Sample Date: Units:	35-37 Knowlton Street post-EPEM							
		35KNOW-1 3/5/09				35KNOW-B 3/5/09			
		μg/m ³		ppbv		μg/m ³		ppbv	
		Method		TO-15		35KNOW-1 9/1/09		35KNOW-B 9/1/09	
Volatile Organic Compounds (VOCs)									
1,1-Dichloroethane									
1,1-Dichloroethylene									
cis-1,2-Dichloroethylene									
Tetrachloroethylene (PCE)									
1,1,1-Trichloroethane (TCA)									
Trichloroethylene (TCE)									

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. μg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4y
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
35-37 Knowlton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		35-37 Knowlton Street post-EPEM (continued)							
		35KNOW-1 12/3/09		35KNOW-B 12/3/09		35KNOW-1 3/2/10		35KNOW-B 3/2/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs)	TO-15								
1,1-Dichloroethane		< 0.81	< 0.20	1.7	0.43	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	3.0	0.76	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.81	< 0.20	0.52 J	0.13 J	< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	71.2	10.5	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	8.1	1.5	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4z
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 4 Morton Street
 Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		4 Morton Street post-EPEM							
		4MORT-1 3/7/09		4MORT-B 3/7/09		4MORT-1 8/10/09		4MORT-B 8/10/09	
		µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv	µg/m³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon Tetrachloride 1,2-Dichloroethane Tetrachloroethylene (PCE)	TO-15	0.61 J	0.097 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		< 0.81	< 0.20	< 1.8	< 0.20	0.65 J	0.16 J	< 0.79	< 0.20
		< 1.4	< 0.20	18	2.6	< 1.4	< 0.20	1.4	0.20

Attachment C 4z

Risk Characterization Data - Indoor Air

Other Streets Area Exposure Area

4 Morton Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		4 Morton Street post-EPEM (continued)					
		4MORT-1 3/4/10		4MORT-B 3/4/10		4MORT-1 12/5/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)							
Carbon Tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane		2.2	0.55	< 0.81	< 0.20	NT	NT
Tetrachloroethylene (PCE)		< 1.4	< 0.20	5.7	0.84	< 1.4	2.2

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.
6. **No pre-EPEM indoor air samples were collected. The EPEM was installed based on sub-slab soil vapor testing results.**
7. Samples collected in March and December 2010 were collected over 24-hour periods from March 3 to 4 and December 4 to 5.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4aa
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
6-8 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		6-8 Morton Street																	
		6MORT-1 6/18/07		6MORT-B 6/18/07		6-8MORT-1 11/7/07		6-8MORT-B 11/7/07											
		µg/m ³		ppbv		µg/m ³		ppbv											
		µg/m ³		ppbv		µg/m ³		ppbv											
Analyte	Method	0.69 J < 1.4		0.11 J < 0.20		< 1.3 1.4		< 0.20 0.20		< 1.3 < 1.4		< 0.20 < 0.20		< 1.3 3.1		< 0.20 0.45			
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)	TO-15																		

Attachment C 4aa
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
6-8 Morton Street
Somerville, Massachusetts

Analyte		6-8 Morton Street (continued)					
		Sample Location:		6MORT-1		6MORT-B	
		Sample Name:	Sample Date:	2/7/08	2/7/08	6/16/08	6/16/08
		Units:		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)		Method					
Carbon tetrachloride		TO-15					
Tetrachloroethylene (PCE)							
				< 1.3	< 0.20	< 1.3	< 0.20
				< 1.4	< 0.20	< 1.4	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4aa
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
6-8 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		6-8 Morton Street (continued)			
		6-8 MORT-1 8/4/09		6-8 MORT-B 8/4/09	
		µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Volatile Organic Compounds (VOCs)				
	Carbon tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	3.3	0.49

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ab
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
10 Morton Street
Somerville, Massachusetts

Sample Location:			10 Morton Street post-EPEM								
Analyte	Method	Sample Name:		10MORT-1		10MORT-B		10MORT-1		10MORT-B	
		Sample Date:		4/3/09		4/3/09		2/12/10		2/12/10	
		Units:		ppbv		ppbv		ppbv		ppbv	
				µg/m ³		µg/m ³		µg/m ³		µg/m ³	
Volatile Organic Compounds (VOCs)	TO-15	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)											

Attachment C 4ab
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
10 Morton Street
Somerville, Massachusetts

Analyte	Sample Location: Sample Name: Sample Date: Units:	10 Morton Street post-EPEM (continued)					
		10MORT-1 11/13/10		10MORT-B 11/13/10		10MORT-1 12/18/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatiles Organic Compounds (VOCs) Trichloroethylene (TCE)	Method TO-15	2.9	0.54	13	2.4	< 1.1	< 0.20
						1.4	0.26

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. NT = Not tested.
6. EPEM = Exposure Pathway Elimination Measure.
7. The samples collected in February 2010 were collected over a 24-hour period from February 11 through 12, 2010.
8. The samples collected in November 2010 were collected over a 24-hour period from November 12 through 13, 2010.
9. The samples collected in December 2010 were collected over a 24-hour period from December 17 through 18, 2010.

Attachment C 4ac
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
11 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date:		11 Morton Street post-EPEM					
		11 MORT-1 10/23/08		11 MORT-B 10/23/08		11MORT-1A 1/21/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane 1,1,1-Trichloroethane (TCA)	Method TO-15	0.63 J	0.10 J	0.69 J	0.11 J	0.88 J	0.14 J
		0.45 J	0.11 J	0.49 J	0.12 J	< 0.81	< 0.20
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
						0.82 J	0.13 J
						< 0.81	< 0.20
						< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ac
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
11 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		11 Morton Street post-EPEM (continued)					
		11MORT-B1 1/21/09		11MORT-B2 1/21/09		11MORT-1 8/11/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		1.6	0.25	1.5	0.24	< 1.3	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	11	2.8
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ac
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
11 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		11 Morton Street post-EPEM (continued)			
		11MORT-1 2/23/10		11MORT-B 2/23/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride 1,2-Dichloroethane 1,1,1-Trichloroethane (TCA)	Method TO-15	< 1.3	< 0.20	< 1.3	< 0.20
		< 0.81	< 0.20	< 0.81	< 0.20
		1.3	0.24	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ad
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
12 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		12 Morton Street post-EPEM							
		12MORT-1A 3/5/08		12MORT-1B 3/5/08		12MORT-B1 3/5/08		12MORT-B2 3/5/08	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)	TO-15	0.62 J	0.099 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20

Attachment C 4ad
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
12 Morton Street
Somerville, Massachusetts

Analyte		12 Morton Street post-EPEM (continued)					
		12MORT-1A 3/21/08		12MORT-1B 3/21/08		12MORT-B1 3/21/08	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)							
Carbon tetrachloride		0.62 J < 1.4	0.099 J < 0.20	0.75 J < 1.4	0.12 J < 0.20	< 1.3 < 1.4	0.60 J < 1.4
Tetrachloroethylene (PCE)							0.095 J < 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. On 3/05/08 and 3/21/08 field duplicate samples were taken from the 1st Floor (1A and 1B) and two from the basement (B1 and B2).
6. EPEM = Exposure Pathway Elimination Measure.
7. The samples from March and November 2010 were collected over 24-hour periods from March 8 to 9 and November 18 to 19.
8. **No pre-EPEM indoor air samples were collected. The EPEM was installed based on sub-slab soil vapor testing results.**

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ad
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
12 Morton Street
Somerville, Massachusetts

12 Morton Street post-EPEM (continued)									
Analyte	Sample Location: Sample Name: Sample Date: Units:	12MORT-1 4/3/09		12MORT-B 4/3/09		12MORT-1 3/9/10		12MORT-B 3/9/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	1.4	0.21

Attachment C 4ad
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
12 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		12 Morton Street post-EPEM (continued)			
		12MORT-1 11/19/10		12MORT-B 11/19/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method				
Volatile Organic Compounds (VOCs)	TO-15				
Carbon tetrachloride		NT < 1.4	NT < 0.20	NT < 1.4	NT < 0.20
Tetrachloroethylene (PCE)					

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. On 3/05/08 and 3/21/08 field duplicate samples were taken from the 1st Floor (1A and 1B) and two from the basement (B1 and B2).
6. EPEM = Exposure Pathway Elimination Measure.
7. The samples from March and November 2010 were collected over 24-hour periods from March 8 to 9 and November 18 to 19.
8. **No pre-EPEM indoor air samples were collected. The EPEM was installed based on sub-slab soil vapor testing results.**

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ae
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
13 Morton Street
Somerville, Massachusetts

Analyte		13 Morton Street					
		Sample Location:		13 MORT-1A		13 MORT-1B	
		Sample Name: Sample Date:		1/21/09		1/21/09	
Volatile Organic Compounds (VOCs)		Units:		ppbv		ppbv	
Carbon tetrachloride		Method		µg/m ³		µg/m ³	
		TO-15		0.62 J		0.61 J	
				0.098 J		0.097 J	
				0.63 J		0.11 J	
				0.63 J		0.10 J	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ae
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
13 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		13 Morton Street			
		13 MORT-1 1/28/10		13 MORT-B 1/28/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method				
Volatile Organic Compounds (VOCs)	TO-15				
Carbon tetrachloride		0.69 J	0.11 J	0.63 J	0.10 J

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4af
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
18 Morton Street
Somerville, Massachusetts

Analyte		18 Morton Street post-EPEM							
		Sample Location:							
		Sample Name:		Sample Date:		Units:			
		Method							
Volatile Organic Compounds (VOCs)		TO-15							
Carbon tetrachloride									
1,2-Dichloroethane									
Tetrachloroethylene (PCE)									
Trichloroethylene (TCE)									

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. concentration above the specified laboratory reporting limit.
5. The samples collected in January 2009 (18MORT-1A and 1B, and 18MORT-B1 and B2) were field duplicates.
6. The samples collected in March 2010 were collected over a 24-hour period from March 10 through 11, 2010.
7. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4af
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
18 Morton Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		18 Morton Street post-EPEM (continued)							
		18MORT-1B 1/17/09		18MORT-B1 1/17/09		18MORT-B2 1/17/09		18MORT-B 3/11/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
		Method							
Analyte	TO-15								
		Volatile Organic Compounds (VOCs)							
		Carbon tetrachloride							
		1,2-Dichloroethane							
Tetrachloroethylene (PCE)		0.69 J	0.11 J	< 1.3	< 0.20	0.61 J	0.097 J	< 1.3	< 0.20
Trichloroethylene (TCE)		0.73 J	0.18 J	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	2.8	0.41
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.5	0.28

General Notes:

- 1 Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. concentration above the specified laboratory reporting limit.
5. The samples collected in January 2009 (18MORT-1A and 1B, and 18MORT-B1 and B2) were field duplicates.
6. The samples collected in March 2010 were collected over a 24-hour period from March 10 through 11, 2010.
7. EPEM = Exposure Pathway Elimination Measure.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ag
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
19-19A Morton Street
Somerville, Massachusetts

Analyte		Location Name:		19-19A Morton Street post-EPEM					
		Sample Name:		19MORT-1		19MORT-B		19MORT-1	
		Sample Date:		9/3/09		9/3/09		1/29/10	
		Units:		µg/m ³		µg/m ³		µg/m ³	
Method		ppbv		ppbv		ppbv		ppbv	
TO-15									
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride		< 1.3		< 0.20		< 1.3		< 0.20	
Dichloroethane, 1,2-		< 0.81		< 0.20		< 0.81		< 0.20	
Tetrachloroethylene (PCE)		< 1.4		< 0.20		< 1.4		< 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.
6. The samples collected in September 2009 were collected over a 24-hour period from September 3 to 4, 2009.
7. The samples collected in January 2010 were collected over a 24-hour period from January 28 to 29, 2010.
8. The samples collected in December 2010 were collected over a 24-hour period from December 6 to 7, 2010.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ag
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
19-19A Morton Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	19-19A Morton Street post-EPEM (continued)			
		19MORT-1 12/7/10		19MORT-B 12/7/10	
		µg/m ³	ppbv	µg/m ³	ppbv
		Method	TO-15		
Volatile Organic Compounds (VOCs)					
Carbon tetrachloride				NT	NT
Dichloroethane, 1,2-				NT	NT
Tetrachloroethylene (PCE)				3.1	0.45
					0.71

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. EPEM = Exposure Pathway Elimination Measure.
6. The samples collected in September 2009 were collected over a 24-hour period from September 3 to 4, 2009.
7. The samples collected in January 2010 were collected over a 24-hour period from January 28 to 29, 2010.
8. The samples collected in December 2010 were collected over a 24-hour period from December 6 to 7, 2010.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ah
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
49 Tufts Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		49 Tufts Street							
		49TUFTS-1 9/6/07		49TUFTS-B 9/6/07		49TUFTS-1 2/19/09		49TUFTS-B 2/19/09	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method								
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		1.0 J	0.16 J	0.94 J	0.15 J	< 1.3	< 0.20	< 1.3	< 0.20
1,2-Dichloroethane		0.45 J	0.11 J	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Tetrachloroethylene (PCE)		1.8	0.27	1.8	0.27	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		0.60 J	0.11 J	0.42 J	0.077 J	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ah
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
49 Tufts Street
Somerville, Massachusetts

49 Tufts Street (continued)							
Sample Location:		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Sample Name:		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Sample Date:		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Units:		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Method		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Analyte		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Volatile Organic Compounds (VOCs)		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Carbon tetrachloride		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
1,2-Dichloroethane		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Tetrachloroethylene (PCE)		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
1,1,1-Trichloroethane (TCA)		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	
Trichloroethylene (TCE)		49TUFTS-1 9/1/09		49TUFTS-B 9/1/09		49TUFTS-1 3/9/10	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ai
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
85 Washington Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		85 Washington Street													
		85WASH-1 11/14/07		85WASH-2 11/14/07		85WASH-AUDI 2/12/08		85WASH-PARK 2/12/08							
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv						
Analyte	Method														
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE)	TO-15														
		0.69 J 1.2 J		0.11 J 0.17 J		< 1.3 1.4		< 0.20 0.21		< 1.3 1.2 J		0.69 J < 1.4		0.11 J < 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. AUDI = Auditorium.
6. PARK = Indoor parking lot attached to the building.
7. 85WASH-1 sample from November 14, 2007 was collected in the auditorium.
8. 85WASH-2 sample from November 14, 2007 was collected in the indoor parking lot.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ai
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
85 Washington Street
Somerville, Massachusetts

Analyte	Sample Location:		85 Washington Street (continued)					
	Sample Name:	Sample Date:	85WASH-AUDI		85WASH-PARK		85WASH-AUDI	
			8/18/08		8/18/08		2/4/09	
Volatile Organic Compounds (VOCs)		Units:	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride			0.75 J < 1.4	0.12 J < 0.20	0.69 J 0.60 J	0.11 J 0.089 J	< 1.3 < 1.4	0.60 J < 1.4
Tetrachloroethylene (PCE)								0.096 J < 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. AUDI = Auditorium.
6. PARK = Indoor parking lot attached to the building.
7. 85WASH-1 sample from November 14, 2007 was collected in the auditorium.
8. 85WASH-2 sample from November 14, 2007 was collected in the indoor parking lot.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4aj
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 91-95 Washington Street
 Somerville, Massachusetts

Analyte	Sample Location: Sample Name: Sample Date: Units:	91-95 Washington Street			
		91 WASH-1 6/30/09		91 WASH-1 1/28/10	
		91-95 WASH-1 11/11/10		91-95 WASH-1 11/11/10	
		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs) Tetrachloroethylene (PCE)	Method TO-15	6.8	1.0	3.7	0.55
				1.6	0.23

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.

Attachment C 4ak
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
97 Washington Street
Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		97 Washington Street													
		97WASH1 6/14/07		97WASHB 6/14/07		97WASH-1 11/5/07		97WASH-B 11/5/07							
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv						
Analyte	Method														
Volatile Organic Compounds (VOCs) Carbon tetrachloride Tetrachloroethylene (PCE) 1,1,1-Trichloroethane (TCA)	TO-15	0.69 J 1.1 JG 0.52 J		0.11 J 0.16 JG 0.096 J		0.69 J 1.4 G 0.76 J		0.11 J 2.0 G 0.14 J		0.60 J 1.5 0.52 J		0.63 J 1.7 0.82 J		0.10 J 0.25 0.15 J	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

- G Duplicate precision outside control limits.
J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ak
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
97 Washington Street
Somerville, Massachusetts

Analyte		97 Washington Street (continued)					
		Sample Location:		97WASH-1		97WASH-B	
		Sample Name: Sample Date:		2/5/08		2/5/08	
		Units:		ppbv		ppbv	
				µg/m ³		µg/m ³	

Attachment C 4aI
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
103 Washington Street
Somerville, Massachusetts

103 Washington Street - No Exposure Pathway Elimination Measure (EPEM) samples collected.

Attachment C 4am
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
105-107 Washington Street
Somerville, Massachusetts

Analyte	Sample Location:		105-107 Washington Street					
	Sample Name:		105-107WASH-1		105-107WASH-B		105WASH-1	
	Sample Date:		2/20/09		2/20/09		9/16/09	
	Units:		µg/m ³		µg/m ³		µg/m ³	
Volatiles Organic Compounds (VOCs)	Method		ppbv		ppbv		ppbv	
Tetrachloroethylene (PCE)	TO-15		0.62 J		1.7		< 1.4	
			0.092 J		0.25		< 0.20	
							< 1.4	
							< 0.20	
							< 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4am

Sample Location: 105-107 Washington Street (continued)			
Sample Name: 105WASH-1		105WASH-B	
Sample Date: 3/19/10		3/19/10	
Units:		µg/m ³	ppbv
Analyte	Method		
Volatile Organic Compounds (VOCs) Tetrachloroethylene (PCE)	TO-15	2.5	1.7
		0.37	12

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4an

Risk Characterization Data - Indoor Air

Other Streets Area Exposure Area

111 Washington Street

Somerville, Massachusetts

Sample Location: Sample Name: Sample Date: Units:		111 Washington Street					
		111 WASH-B 6/30/09		111 WASH-B 3/3/10		111 WASH-B 11/22/10	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs) Tetrachloroethylene (PCE)	TO-15	1.7	0.25	< 1.4	< 0.20	< 1.4	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Attachment C 4ao
Risk Characterization Data - Indoor Air
Other Streets Area Exposure Area
121 Washington Street
Somerville, Massachusetts

Analyte	Sample Location:		121 Washington Street			
	Sample Name:	Sample Date:	121WASH-1A 11/6/2007		121WASH-1B 11/6/2007	
	Units:		121WASH-1A 11/6/2007		121WASH-1B 11/6/2007	
	Method		µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	TO-15					
Carbon tetrachloride			0.82 J	0.13 J	0.88 J	0.14 J
Tetrachloroethylene (PCE)			1.5	0.22	1.4	0.20
1,1,1-Trichloroethane (TCA)			< 1.1	< 0.20	< 1.1	< 0.20
					0.69 J	0.11 J
					< 1.4	< 0.20
					< 1.1	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 4ao
 Risk Characterization Data - Indoor Air
 Other Streets Area Exposure Area
 121 Washington Street
 Somerville, Massachusetts

Sample Location:		121 Washington Street (continued)			
		121WASH-1A 6/9/2008		121WASH-1B 6/9/2008	
Sample Name: Sample Date:					
Units:					
Analyte	Method				
Volatile Organic Compounds (VOCs)	TO-15				
Carbon tetrachloride					
Tetrachloroethylene (PCE)					
1,1,1-Trichloroethane (TCA)					
		0.75 J	0.12 J	0.75 J	0.12 J
		1.6	0.24	1.6	0.24
		1.3	0.24	1.4	0.26

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

**Attachment C 4af
Risk Characterization Data - Indoor Air
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts**

No Indoor Air Samples Were Assessed Within the "Within Neighborhood Streets Area" Exposure Area

Attachment C 5a
Risk Characterization Data - Outdoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

50 Tufts-North Parking Lot									
Location Name:		04516-50T-NP		04516-NP		50Tufts-NP		50TUFTS-NP	
Sample Name:		5/1/2007		5/14/2007		6/28/2007		10/4/2007	
Sample Date:									
Units:		µg/m ³		ppbv		µg/m ³		ppbv	
Method									
Analyte									
TO-15									
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride	0.75 J		0.12 J		< 1.3		< 0.2		< 1.3
Chloroethane	< 0.53		< 0.20		< 0.53		< 0.2		< 0.53
Dichloroethane, 1,1-	< 0.81		< 0.20		< 0.81		< 0.2		< 0.81
Dichloroethane, 1,2-	< 0.81		< 0.20		< 0.81		< 0.2		< 0.81
Dichloroethylene, cis-1,2-	< 0.79		< 0.20		< 0.79		< 0.2		< 0.79
Dichloroethylene, 1,1-	< 0.79		< 0.20		< 0.79		< 0.2		< 0.79
Tetrachloroethylene (PCE)	1.8		0.26		7.5		1.1		3.9
Trans-1,2-Dichloroethylene	< 0.79		< 0.20		< 0.79		< 0.2		< 0.79
Trichloroethane, 1,1,1- (TCA)	0.38 J		0.070 J		0.98 J		0.18 J		0.50 J
Trichloroethylene (TCE)	< 1.1		< 0.20		0.64 J		0.12 J		< 1.1
Vinyl chloride	< 0.51		< 0.20		< 0.51		< 0.2		< 0.51

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5a
Risk Characterization Data - Outdoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

50 Tufts-North Parking Lot (continued)						
Location Name:		50T-NP		50TUFTS-NP		50TUFTS-NP2
Sample Name:		12/7/2007		5/1/2008		10/4/2007
Sample Date:		µg/m ³	ppbv	µg/m ³	ppbv	ppbv
Units:						
Analyte	Method					
TO-15						
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride		0.69 J	0.11 J	0.63 J	0.10 J	< 1.3
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53
Dichloroethane, 1,1-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81
Dichloroethylene, cis-1,2-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79
Dichloroethylene, 1,1-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79
Tetrachloroethylene (PCE)		2.2	0.33	0.65 J	0.096 J	7.5
Trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79
Trichloroethane, 1,1,1- (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	1.2
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	0.75 J
Vinyl chloride		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51
						< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5a
Risk Characterization Data - Outdoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		Location Name: Sample Name: Sample Date: Units:		50 Tufts-South Parking Lot							
				04516-50T-SP 5/1/2007		04516-SP 5/14/2007		50Tufts-SP 6/28/2007		50TUFTS-SP 10/4/2007	
				µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method		TO-15									
Volatile Organic Compounds (VOCs)											
Carbon tetrachloride				0.69 J	0.11 J	0.63 J	0.1 J	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane				< 0.53	< 0.20	< 0.53	< 0.2	< 0.53	< 0.20	< 0.53	< 0.20
Dichloroethane, 1,1-				< 0.81	< 0.20	< 0.81	< 0.2	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethane, 1,2-				< 0.81	< 0.20	< 0.81	< 0.2	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethylene, cis-1,2-				< 0.79	< 0.20	< 0.79	< 0.2	< 0.79	< 0.20	< 0.79	< 0.20
Dichloroethylene, 1,1-				< 0.79	< 0.20	< 0.79	< 0.2	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)				3.7	0.54	2.8	0.42	1.8 G	0.26 G	< 1.3 J	< 0.19 J
Trans-1,2-Dichloroethylene				< 0.79	< 0.20	< 0.79	< 0.2	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethane, 1,1,1- (TCA)				< 1.1	< 0.20	< 1.1	< 0.2	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)				< 1.1	< 0.20	< 1.1	< 0.2	< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride				< 0.51	< 0.20	< 0.51	< 0.2	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5a
Risk Characterization Data - Outdoor Air
Property Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	50 Tufts-South Parking Lot (continued)					
		50T-SP 12/7/2007		50TUFTS-SP 5/1/2008		50TUFTS-SP2 10/4/2007	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	TO-15						
Carbon tetrachloride		0.75 J	0.12 J	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
Dichloroethane, 1,1-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethylene, cis-1,2-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Dichloroethylene, 1,1-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		2.0	0.29	1.4	0.21	9.5	1.4
Trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethane, 1,1,1- (TCA)		< 1.1	< 0.20	1.6	0.30	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5b
Risk Characterization Data - Outdoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Tufts-O2									
	Location Name:		Sample Name:		Sample Date:		Units:		Method	
	TUFTS-O-2A		TUFTS-O-2B		TUFTS-O-2A		TUFTS-O-2B		TUFTS-O-2A	
	3/23/2006	3/23/2006	3/24/2006	3/24/2006	6/29/2006	6/29/2006	6/29/2006	6/29/2006	9/28/2006	10/2/2006
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)										
Carbon tetrachloride	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	0.69 J	0.11 J	< 1.3	< 0.20
Chloroethane	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethylene (TCE)	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	5.4	0.8	< 1.4	0.24
Vinyl chloride	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.1	0.21	< 1.1	0.14 J
	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	0.91 J	0.17 J	< 1.1	< 0.20
	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "J" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5b
Risk Characterization Data - Outdoor Air
60 Tufts Street Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:		Tufts-O3			
Sample Name:		TUFTS-0-2A		TUFTS-0-2B	
Sample Date:		12/15/2006		12/18/2006	
Units:		ppbv		ppbv	
Analyte	Method	µg/m³	ppbv	µg/m³	ppbv
Volatile Organic Compounds (VOCs)					
Carbon tetrachloride	TO-15	< 1.3	< 0.20	0.60 J	0.095 J
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		2.0	0.30	2.8	0.41
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 0.98 J	< 0.18 J
Trichloroethylene (TCE)		< 1.1	< 0.20	< 0.59 J	< 0.11 J
Vinyl chloride	< 0.51	< 0.20	< 0.51	< 0.20	

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "J" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Note:

- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	Tufts-O1							
		TUFTS-O-1A 3/23/2006		TUFTS-O-1B 3/24/2006		TUFTS-O-1A 6/28/2006		TUFTS-O-1B 6/28/2006	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Method	TO-15								
Volatile Organic Compounds (VOCs)									
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name:		Tufts-O1 (continued)						Tufts-O2			
	Sample Name:		TUFTS-O-1A		TUFTS-O-1B		TUFTS-O-2A		TUFTS-O-2B		TUFTS-O-2A	
	Sample Date:		12/15/2006		12/18/2006		3/23/2006		3/24/2006		6/29/2006	
Units:												
Method												
TO-15												
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride												
Chloroethane												
1,1-Dichloroethane												
1,2-Dichloroethane												
1,1-Dichloroethylene												
cis-1,2-Dichloroethylene												
trans-1,2-Dichloroethylene												
Tetrachloroethylene (PCE)												
1,1,1-Trichloroethane (TCA)												
Trichloroethylene (TCE)												
Vinyl chloride												

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "L" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	Tufts-O2 (continued)							
		TUFTS-O-2B 6/29/2006		TUFTS-O-2A 9/28/2006		TUFTS-O-2B 10/2/2006		TUFTS-O-2A 12/15/2006	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	TO-15								
Carbon tetrachloride		0.69 J	0.11 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethylene (TCE)		5.4	0.80	< 1.4	< 0.20	1.6	0.24	2.0	0.41
Vinyl chloride		1.1	0.21	< 1.1	< 0.20	0.76 J	0.14 J	< 1.1	< 0.18 J
		0.91 J	0.17 J	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.11 J
		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			Tufts-O3		50 Tufts-North Parking Lot							
Sample Name:			TUFTS-O-3A		04516-50T-NP		04516-NP		50Tufts-NP		50TUFTS-NP	
Sample Date:			10/2/2006		5/1/2007		5/14/2007		6/28/2007		10/4/2007	
Units:			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method											
TO-15												
Volatile Organic Compounds (VOCs)												
Carbon tetrachloride			< 1.3	< 0.20	0.75 J	0.12 J	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane			< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane			< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane			< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)			< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)			< 1.4	< 0.20	1.8	0.26	7.5	1.1	12 G	1.7 G	3.9	0.57
Trichloroethylene (TCE)			< 1.1	< 0.20	0.38 J	0.070 J	0.98 J	0.18 J	2.0	0.36	0.50 J	0.091 J
Vinyl chloride			< 1.1	< 0.20	< 1.1	< 0.20	0.64 J	0.12 J	1.6	0.30	< 1.1	< 0.20
			< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name:			50 Tufts-North Parking Lot (continued)						50 Tufts-South Parking Lot			
Sample Name:			50T-NP		50TUFTS-NP		50TUFTS-NP2		04516-50T-SP		04516-SP	
Sample Date:			12/7/2007		5/1/2008		10/4/2007		5/1/2007		5/14/2007	
Units:			µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method											
Volatile Organic Compounds (VOCs)	TO-15											
	Carbon tetrachloride		0.69 J	0.11 J	0.63 J	0.10 J	< 1.3	0.69 J	0.63 J	0.1 J	0.63 J	0.1 J
	Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.53	< 0.53	< 0.20	< 0.53	< 0.20
	1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.81	< 0.81	< 0.20	< 0.81	< 0.20
	1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.81	< 0.81	< 0.20	< 0.81	< 0.20
	1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.79	< 0.79	< 0.20	< 0.79	< 0.20
	cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.79	< 0.79	< 0.20	< 0.79	< 0.20
	trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.79	< 0.79	< 0.20	< 0.79	< 0.20
	Tetrachloroethylene (PCE)		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.79	< 0.79	< 0.20	< 0.79	< 0.20
	1,1,1-Trichloroethane (TCA)		2.2	0.33	0.65 J	0.096 J	7.5	3.7	2.8	0.54	2.8	0.42
	Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	1.2	< 1.1	< 1.1	< 0.20	< 1.1	< 0.20
	Vinyl chloride		< 1.1	< 0.20	< 1.1	< 0.20	0.75 J	< 1.1	< 1.1	< 0.20	< 1.1	< 0.20
			< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.51	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5c
Risk Characterization Data - Outdoor Air
Tufts Street and MBTA Railroad Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name: Sample Name: Sample Date:		50 Tufts-South Parking Lot (continued)									
		50Tufts-SP 6/28/2007		50TUFTS-SP 10/4/2007		50T-SP 12/7/2007		50TUFTS-SP 5/1/2008		50TUFTS-SP2 10/4/2007	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method	Units:									
Volatile Organic Compounds (VOCs)	TO-15										
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	0.75 J	0.12 J	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
1,1,1-Trichloroethane (TCA)		1.8 G	0.26 G	< 1.3 J	< 0.19 J	2.0	0.29	1.4	0.21	9.5	1.4
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	1.6	0.30	< 1.1	< 0.20
Vinyl chloride		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- G The result is estimated due to duplicate precision outside control limits.
- J The reported result is below the laboratory reporting limit and is estimated.

Attachment C 5d
 Risk Characterization Data - Outdoor Air
 Alston Street Area Exposure Area
 50 Tufts Street
 Somerville, Massachusetts

Location Name:		Tufts-O4	
Sample Name:		TUFTS-O-4A	
Sample Date:		10/2/2006	
Units:		ppbv	
Analyte	Method	$\mu\text{g}/\text{m}^3$	
Volatile Organic Compounds (VOCs)			
Carbon tetrachloride	TO-15	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20
1,1-Dichloroethane		< 0.81	< 0.20
1,2-Dichloroethane		< 0.81	< 0.20
1,1-Dichloroethylene		< 0.79	< 0.20
cis-1,2-Dichloroethylene		< 0.79	< 0.20
trans-1,2-Dichloroethylene		< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20
1,1,1-Trichloroethane (TCA)		< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20
Vinyl chloride		< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample location refer to Figure 7-6.

Attachment C 5e
Risk Characterization Data - Outdoor Air
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Location Name: Sample Name: Sample Date: Units:		150 Glen-O1					
		150 GLEN-0-1A 12/27/2006		150 GLEN-0-1B 12/28/2006		150 GLEN-0-1A 1/6/2007	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Analyte	Method						
Volatile Organic Compounds (VOCs) Carbon tetrachloride Chloroethane Dichloroethane, 1,1- Dichloroethane, 1,2- Dichloroethylene, cis-1,2- Dichloroethylene, 1,1- Tetrachloroethylene (PCE) Trans-1,2-Dichloroethylene Trichloroethane, 1,1,1- (TCA) Trichloroethylene (TCE) Vinyl chloride	TO-15	< 1.3	< 0.20	< 1.3	< 0.20	0.52 J J+	0.083 J J+
		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "L" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
- J+ The reported result is estimated.

Attachment C 5e
Risk Characterization Data - Outdoor Air
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	Method	150 Glen-O2			
			150 GLEN-0-2A 12/27/2006		150 GLEN-0-2B 12/28/2006	
			µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)						
Carbon tetrachloride		TO-15	1.1 J	0.17 J	< 1.3	0.52 J J+
Chloroethane			< 0.53	< 0.20	< 0.53	< 0.20
Dichloroethane, 1,1-			< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethane, 1,2-			< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethylene, cis-1,2-			< 0.79	< 0.20	< 0.79	< 0.20
Dichloroethylene, 1,1-			< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)			< 1.4	< 0.20	< 1.4	< 0.20
Trans-1,2-Dichloroethylene			< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethane, 1,1,1- (TCA)			< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)			< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride			< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 5e
Risk Characterization Data - Outdoor Air
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		150 Glen-Roof											
		150 GLEN-ROOF B 2/8/2007		150 GLEN-ROOF 2/8/2007		150 GLEN-ROOF 3/8/2007		150 GLEN-ROOF 4/20/2007		150 GLEN-ROOF 5/17/2007		150 GLEN-ROOF 8/9/2007	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Location Name: Sample Name: Sample Date: Units:													
Method													
TO-15													
Volatile Organic Compounds (VOCs)													
Carbon tetrachloride		< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
Dichloroethane, 1,1-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethylene, cis-1,2-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Dichloroethylene, 1,1-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20	< 1.4	< 0.20
Trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethane, 1,1,1- (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 5e
Risk Characterization Data - Outdoor Air
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte		150 Glen-Roof (continued)											
		Location Name:			150 GLEN-ROOF			150 GLEN-ROOF			150 GLEN-ROOF		
		Sample Name:			10/14/2007			11/14/2007			12/17/2007		
		Sample Date:			µg/m ³			ppbv			µg/m ³		
		Units:											
		Method											
Volatiles Organic Compounds (VOCs)		TO-15											
Carbon tetrachloride					< 1.3			< 0.20			< 1.3		
Chloroethane					< 0.53			< 0.20			< 0.53		
Dichloroethane, 1,1-					< 0.81			< 0.20			< 0.81		
Dichloroethane, 1,2-					< 0.81			< 0.20			< 0.81		
Dichloroethylene, cis-1,2-					< 0.79			< 0.20			< 0.79		
Dichloroethylene, 1,1-					< 0.79			< 0.20			< 0.79		
Tetrachloroethylene (PCE)					< 1.4			< 0.20			< 1.4		
Trans-1,2-Dichloroethylene					< 0.79			< 0.20			< 0.79		
Trichloroethane, 1,1,1- (TCA)					< 1.1			< 0.20			< 1.1		
Trichloroethylene (TCE)					< 1.1			< 0.20			< 1.1		
Vinyl chloride					< 0.51			< 0.20			< 0.51		

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

Attachment C 5e
Risk Characterization Data - Outdoor Air
Other Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts

Analyte	Location Name: Sample Name: Sample Date: Units:	150 Glen-Roof (continued)				Tufts-O5		Tufts-O6	
		150 GLEN-ROOF 2/19/2008		150 GLEN-ROOF 9/10/2007		TUFTS-O-5A 10/2/2006		TUFTS-O-6A 10/2/2006	
		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Volatile Organic Compounds (VOCs)	Method TO-15								
Carbon tetrachloride		< 1.3	< 0.20	0.69 J	0.11 J	< 1.3	< 0.20	< 1.3	< 0.20
Chloroethane		< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20	< 0.53	< 0.20
Dichloroethane, 1,1-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethane, 1,2-		< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20	< 0.81	< 0.20
Dichloroethylene, cis-1,2-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Dichloroethylene, 1,1-		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Tetrachloroethylene (PCE)		< 1.4	< 0.20	1.2 J	0.18 J	< 1.4	< 0.20	< 1.4	< 0.20
Trans-1,2-Dichloroethylene		< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20	< 0.79	< 0.20
Trichloroethane, 1,1,1- (TCA)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Trichloroethylene (TCE)		< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20	< 1.1	< 0.20
Vinyl chloride		< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20	< 0.51	< 0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the attached laboratory data sheets.
2. µg/m³ = micrograms per cubic meter.
3. ppbv = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.
5. For sample locations refer to Figure 7-6.
6. NT = not tested.

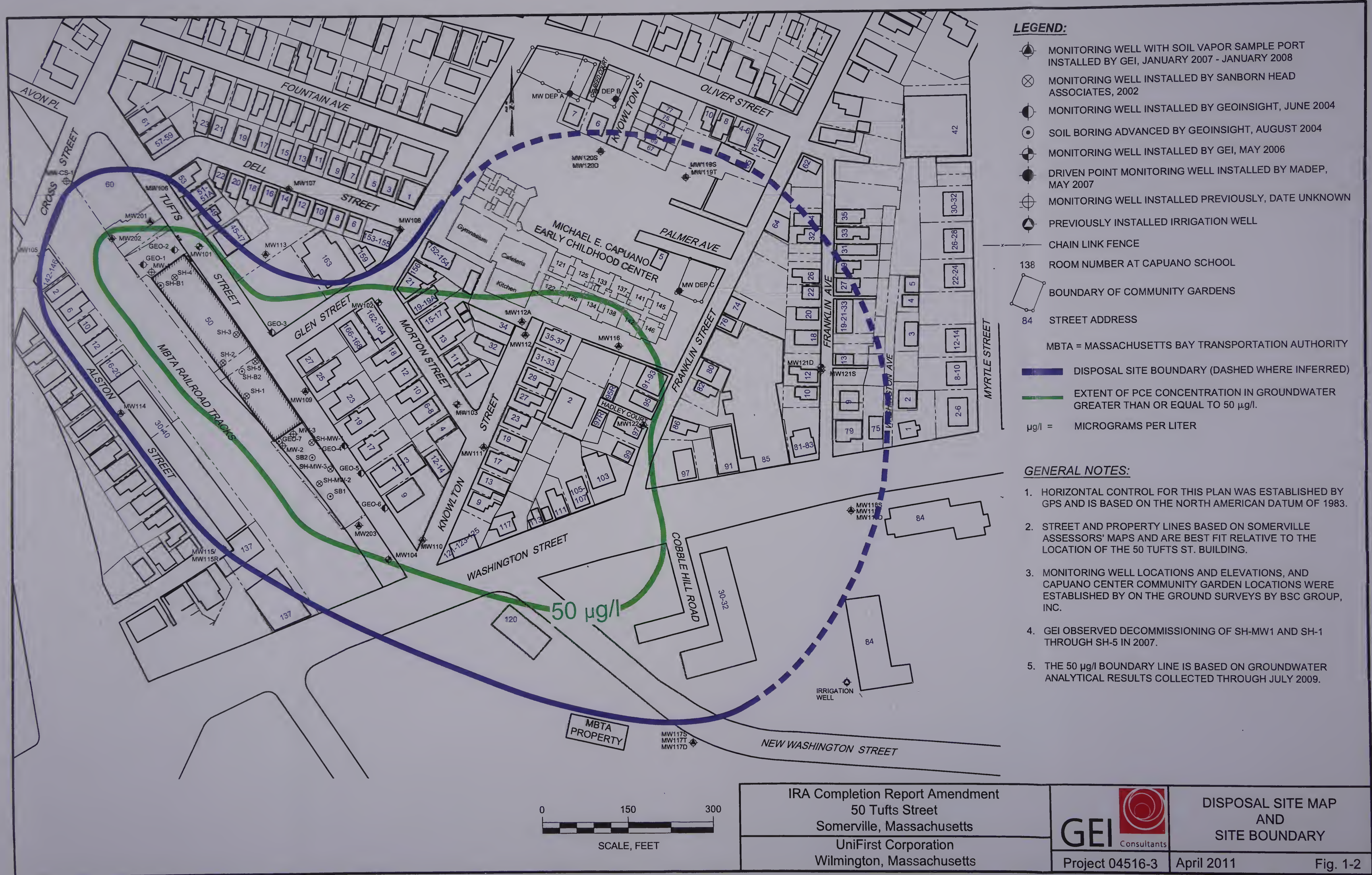
Qualifying Notes:

- J The reported result is below the laboratory reporting limit and is estimated.
J+ The reported result is estimated.

**Attachment C 5f
Risk Characterization Data - Outdoor Air
Neighborhood Streets Area Exposure Area
50 Tufts Street
Somerville, Massachusetts**

No Outdoor Air Samples Were Assessed Within the "Within Neighborhood Streets Area" Exposure Area

FIGURES REFERENCED IN THIS DOCUMENT



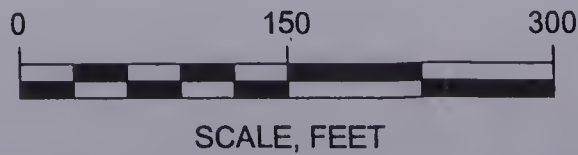


LEGEND:

- MONITORING WELL WITH SOIL VAPOR SAMPLE PORT INSTALLED BY GEI, JANUARY 2007 - JANUARY 2008
- MONITORING WELL INSTALLED BY SANBORN HEAD ASSOCIATES, 2002
- MONITORING WELL INSTALLED BY GEOINSIGHT, JUNE 2004
- SOIL BORING ADVANCED BY GEOINSIGHT, AUGUST 2004
- MONITORING WELL INSTALLED BY GEI, MAY 2006
- DRIVEN POINT MONITORING WELL INSTALLED BY MADEP, MAY 2007
- MONITORING WELL INSTALLED PREVIOUSLY, DATE UNKNOWN
- PREVIOUSLY INSTALLED IRRIGATION WELL
- CHAIN LINK FENCE
- 138 ROOM NUMBER AT CAPUANO SCHOOL
- BOUNDARY OF COMMUNITY GARDENS
- 84 STREET ADDRESS
- MBTA = MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GENERAL NOTES:

1. HORIZONTAL CONTROL FOR THIS PLAN WAS ESTABLISHED BY GPS AND IS BASED ON THE NORTH AMERICAN DATUM OF 1983.
2. STREET AND PROPERTY LINES BASED ON SOMERVILLE ASSESSORS' MAPS AND ARE BEST FIT RELATIVE TO THE LOCATION OF THE 50 TUFTS ST. BUILDING.
3. MONITORING WELL LOCATIONS AND ELEVATIONS, AND CAPUANO CENTER COMMUNITY GARDEN LOCATIONS WERE ESTABLISHED BY ON THE GROUND SURVEYS BY BSC GROUP, INC.
4. GEI OBSERVED ABANDONMENT OF SH-MW1 AND SH-1 THROUGH SH-5 IN 2007.



Phase II CSA and Phase III RAP
50 Tufts Street
Somerville, Massachusetts
UniFirst Corporation
Wilmington, Massachusetts



MONITORING WELL AND
BORING LOCATIONS

Project 04516-2

July 2008

Fig. 4-1

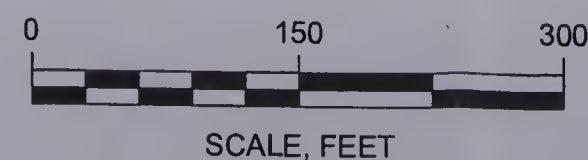


LEGEND:

- MONITORING WELL WITH SOIL VAPOR SAMPLE PORT INSTALLED BY GEI, JANUARY 2007 - JANUARY 2008
 - MONITORING WELL INSTALLED BY SANBORN HEAD ASSOCIATES, 2002
 - MONITORING WELL INSTALLED BY GEOINSIGHT, JUNE 2004
 - SOIL BORING ADVANCED BY GEOINSIGHT, AUGUST 2004
 - MONITORING WELL INSTALLED BY GEI, MAY 2006
 - DRIVEN POINT MONITORING WELL INSTALLED BY MADEP, MAY 2007
 - MONITORING WELL INSTALLED PREVIOUSLY, DATE UNKNOWN
 - PREVIOUSLY INSTALLED IRRIGATION WELL
 - CHAIN LINK FENCE
 - 138 ROOM NUMBER AT CAPUANO SCHOOL
 - BOUNDARY OF COMMUNITY GARDENS
 - 84 STREET ADDRESS
 - APPROXIMATE SHALLOW SOIL SAMPLING LOCATION
- MBTA = MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GENERAL NOTES:

1. HORIZONTAL CONTROL FOR THIS PLAN WAS ESTABLISHED BY GPS AND IS BASED ON THE NORTH AMERICAN DATUM OF 1983.
2. STREET AND PROPERTY LINES BASED ON SOMERVILLE ASSESSORS' MAPS AND ARE BEST FIT RELATIVE TO THE LOCATION OF THE 50 TUFTS ST. BUILDING.
3. MONITORING WELL LOCATIONS AND ELEVATIONS, AND CAPUANO CENTER COMMUNITY GARDEN LOCATIONS WERE ESTABLISHED BY ON THE GROUND SURVEYS BY BSC GROUP, INC.
4. GEI OBSERVED ABANDONMENT OF SH-MW1 AND SH-1 THROUGH SH-5 IN 2007.
5. SHALLOW SOIL SAMPLING LOCATIONS ARE SHOWN BASED ON RELATIVE LOCATIONS OF KNOWN SITE FEATURES.



Phase II CSA and Phase III RAP
50 Tufts Street
Somerville, Massachusetts
UniFirst Corporation
Wilmington, Massachusetts

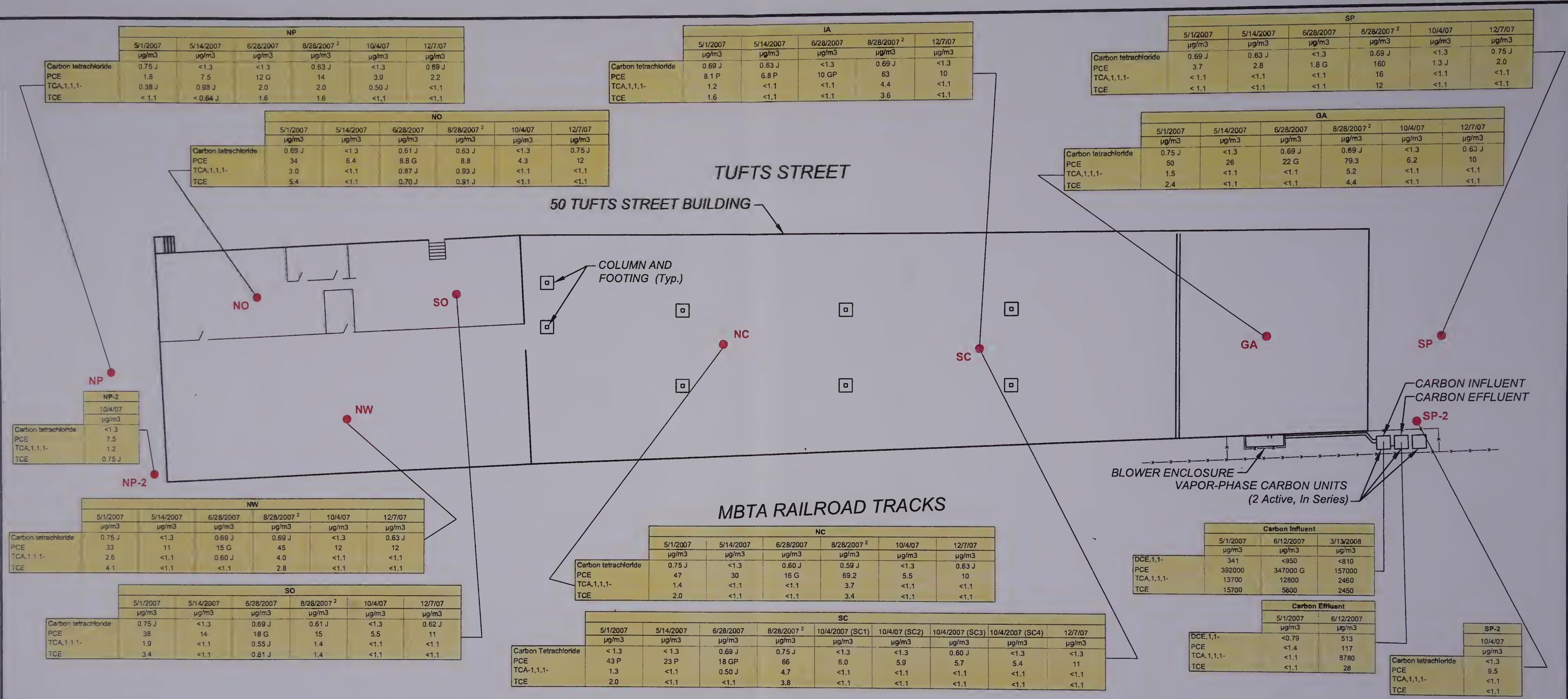


SHALLOW SOIL
SAMPLING LOCATIONS

Project 04516-2

July 2008

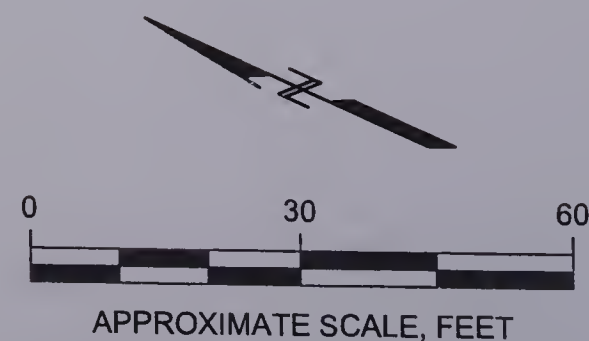
Fig. 4-2



NOTES:

- FIGURE BASED ON PLAN TITLED "INTERSTATE UNIFORM ADDN., TUFTS STREET SOMERVILLE, MASS." BY STRUCTURAL SYSTEMS, INC. DATED DECEMBER 2, 1976.
- AUGUST 28, 2007 DATA WAS COLLECTED WHILE PCE CONTAMINATED SOIL FROM SVE INSTALLATION WAS STORED ON-SITE IN ROLL-OFF CONTAINERS.
- ONLY DETECTED CHLORINATED VOCs ARE SHOWN HERE.
- "ND" = NOT DETECTED.
- J = THE REPORTED RESULT IS BELOW THE LABORATORY REPORTING LIMITS AND IS ESTIMATED.
- G = THE REPORTED RESULT IS ESTIMATED DUE TO LABORATORY DUPLICATE PRECISION.
- P = THE REPORTED RESULT IS ESTIMATED DUE TO FIELD DUPLICSTE PRECISION OUTSIDE CONTROL LIMITS.
- "FD" = FIELD DUPLICATE

- PCE = TETRACHLOROETHYLENE.
- TCA 1,1,1 = TRICHLOROETHANE,1,1,1-.
- TCE = TRICHLOROETHYLENE.
- DCE,1,1 = DICHLOROETHYLENE,1,1-.



LEGEND:

- GA INDOOR AIR MONITORING LOCATION (3'-9" ABOVE SLAB)
- GA GARAGE AREA
- NC NORTH CENTRAL WAREHOUSE
- NO NORTH OFFICE
- NP NORTH PARKING LOT
- NW NORTH WAREHOUSE
- SC SOUTH CENTRAL WAREHOUSE
- SO SOUTH OFFICE
- SP SOUTH PARKING LOT
- IA INDOOR AIR DUPLICATE OF SC

Phase II CSA and Phase III RAP 50 Tufts Street Somerville, Massachusetts UniFirst Corporation Wilmington, Massachusetts			50 TUFTS STREET INDOOR AND OUTDOOR AIR LABORATORY TESTING RESULTS	
			Project 04516-2	July 2008

Analyte	Outdoor, Northeast Corner of 50 Tufts Street															
	045160-Tufts-O-1A 3/23/06		045160-Tufts-O-1B 3/24/06		045160-Tufts-O-1B 6/28/06		045160-Tufts-O-2B 6/28/06		045162-Tufts-O-2A 9/28/06		045162-Tufts-O-2B 10/2/06		045160-Tufts-O-1A 12/15/06		045160-Tufts-O-1B 12/18/06	
	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV	ug/m ³	ppbV
Carbon Tetrachloride	<1.3	<0.20	<1.3	<0.20	0.69 J	0.11 J	0.69 J	0.11 J	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	0.82	0.13
Chloromethane	1.1 L	0.53 L	1.1 L	0.55 L	1.4	0.70	1.4	0.66	NT	NT	NT	NT	NT	NT	NT	NT
Methylene chloride	<1.2 J*	<0.35 J*	<0.97 J*	<0.28 J*	<3.0 J*	<0.86 J*	<5.6 J*	<1.6 J*	NT	NT	NT	NT	NT	NT	NT	NT
PCE	<1.4	<0.20	<1.4	<0.20	8.1	1.2	5.4	0.80	<1.4	<0.20	1.6	0.24	0.88 J	0.13 J	2.7	0.4
TCA, 1,1,1-	<1.1	<0.20	<1.1	<0.20	0.65 J	0.12 J	1.1	0.21	<1.1	<0.20	0.75 J	0.14 J	<1.1	<0.20	<1.1	<0.20
TCE	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	0.91 J	0.17 J	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

		North Parking Lot, 50 Tufts Street													
		04516-SOT-4P 5/1/2007		04516-SP 5/14/2007		SOTufts-SP 5/28/2007		SOT-SP 6/28/2007		SOTufts-SP 10/4/2007		SOTufts-SP2 (FD) 10/4/2007		SOT-SP 12/7/2007	
Analyte		µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride		0.75 J	0.12 J	<1.3	<0.2	<1.3	<0.20	0.83 J	0.10 J	<1.3	<0.20	<1.3	<0.20	0.69 J	0.11 J
	PCE		0.26	7.5	1.1	12 G	1.7 G	14	2	3.9	0.57	7.5	1.1	2.2	0.33
	TCA 1,1,1-	0.38 J	0.070 J	0.98 J	0.19 J	2	0.36	2	0.36	0.50 J	0.091 J	1.2	0.22	<1.1	<0.20
	TCE	<1.1	<0.20	0.64 J	0.12 J	1.60	0.3	1.6	0.29	<1.1	<0.20	0.75 J	0.14 J	<1.1	<0.20
	Total VOCs	1.8	0.26	7.5	1.1	15.6	2.36	17.63	2.65	3.9	0.57	8.7	1.32	2.2	0.33

Analyte	South Parking Lot, 50 Tufts Street													
	04516-SOT-SP		04516-SP		SOTufts-SP		SOT-SP		SOTufts-SP		SOTufts-SP2 (FD)		SOT-SP	
	5/1/2007		5/14/2007		6/28/2007		8/28/2007		10/4/2007		10/4/2007		12/7/2007	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride	0.69 J	0.11 J	0.63 J	0.1 J	<1.3	<0.20	0.69 J	0.11 J	<1.3	<0.20	<1.3	<0.20	0.75 J	0.12 J
PCE	3.7	0.54	2.8	0.42	1.8 G	0.26 G	180	28.6	1.3 J	0.19 J	9.5	1.4	2.0	0.29
TCA, 1,1,1-	<1.1	<0.20	<1.1	<0.2	<1.1	<0.20	16	2.9	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20
TCE	<1.1	<0.20	<1.1	<0.2	<1.1	<0.20	12	2.2	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20
Total VOCs	3.7	0.54	2.8	0.42	1.8	0.28	188	28.7	ND	ND	9.5	1.4	2.0	0.29

Analyte	Outdoor, In Tree In Front of 17 Tufts Street															
	045160-Tufts-O-2A 3/23/06		045160-Tufts-O-2B 3/24/06		045160-Tufts-O-1A 6/28/06		045162-Tufts-O-2A 6/29/06		045162-Tufts-O-1A 9/28/06		045162-Tufts-O-1B 10/2/06		045160-Tufts-O-2A 12/15/06		045160-Tufts-O-2B 12/18/06	
	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv	ug/m ³	ppbv
Carbon Tetrachloride	<1.3	<0.81	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	0.6	0.095
Chloromethane	1.3 L	0.62 L	1.3 L	0.81 L	1.2	0.57	1.8	0.89	NT	NT	NT	NT	NT	NT	NT	NT
Methylene chloride	<1.9 M	<0.56 J+	<0.83 J+	<0.24 J+	<1.3 J+	<0.37 J+	<5.9 J+	<1.7 J+	NT	NT	NT	NT	NT	NT	NT	NT
PCE	<1.4	<0.20	<1.4	<0.20	1.2 J	0.18 J	2.4	0.36	<1.4	<0.20	<1.4	<0.20	2	0.3	2.8	0.41
TCA, 1,1,1-	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	0.98	0.18
TCE	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	0.59	0.11

LABORATORY DATA TABLE NOTES:

- CONCENTRATIONS OF PCE AND TCE ARE SHOWN FOR EACH SAMPLE.
- < = THE ANALYTE WAS NOT DETECTED AT A CONCENTRATION ABOVE THE LABORATORY REPORTING LIMIT.
- PCE = TETRACHLOROETHYLENE
- TCE = TRICHLOROETHYLENE
- TCA, 1,1,1 = TRICHLOROETHANE, 1,1,1-
- J = THE REPORTED RESULTS IS BELOW THE REPORTING LIMIT AND IS ESTIMATED.

GENERAL NOTES:

- HORIZONTAL CONTROL FOR THIS PLAN WAS ESTABLISHED BY GPS AND IS BASED ON THE NORTH AMERICAN DATUM OF 1983.
- VERTICAL CONTROL FOR THIS PLAN WAS ESTABLISHED BY GPS AND IS BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988.
- BUILDINGS, STREET, AND PROPERTY LINES BASED ON SOMERVILLE ASSESSORS' MAPS.
- CAPUANO CENTER BUILDING IS BASED ON DRAWING A0.2 FROM THE ARCHITECTURAL BID SET OF "THE EDGERTY EARLY CHILDHOOD DEVELOPMENT CENTER" BY HMFH ARCHITECTS, INC., DATED AUGUST 10, 2001.
- AIR SAMPLING LOCATIONS SHOWN ON THE FIGURE ARE APPROXIMATE.
- * - CAPUANO CENTER ROOF SAMPLE TAKEN AT VARIOUS LOCATIONS BASED ON WIND DIRECTION.

LEGEND:

- CHAIN LINK FENCE
- ROOM NUMBER AT CAPUANO SCHOOL
- BOUNDARY OF COMMUNITY GARDENS
- STREET ADDRESS
- OUTDOOR AIR SAMPLING LOCATION, JANUARY 2007
- OUTDOOR AIR SAMPLING LOCATION, OCTOBER AND DECEMBER 2006
- OUTDOOR AIR SAMPLING LOCATION, OCTOBER 2006
- CAPUANO CENTER OUTDOOR AIR SAMPLING LOCATION
- MBTA = MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Analyte	Capuano Center, Downwind from Blower Stack, on Roof																							
	150 GLEN-ROOF B 2/8/2007		150 GLEN-ROOF B 2/8/2007		150GLEN-ROOF 3/8/2007		150 GLEN-ROOF 4/28/2007		150 GLEN-ROOF 5/17/2007		150GLEN-ROOF 8/9/2007		150GLEN-ROOF 8/10/2007		150GLEN-ROOF 10/14/2007		150GLEN-ROOF 11/14/2007		150GLEN-ROOF 12/17/2007		150GLEN-ROOF 1/21/2008		150GLEN-ROOF 2/18/2008	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride	<1.3	<1.3	<0.20	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	0.89 J	0.11 J	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20	<1.3	<0.20
PCE	<1.4	<1.4	<0.20	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	1.2 J	0.18 J	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20
TCE	<1.1	<1.1	<0.20	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

Capuano Center, Outside of School by Day Care Window						
Analyte	150 GLEN-0-2A 12/27/2006		150 GLEN-0-2B 12/28/2006		150 GLEN-0-2A 1/6/2007	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride	1.1 J	0.17 J	<1.3	<0.20	0.52 J S	0.082 J S
PCE	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20
TCE	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

Capuano Center, Outside of School by Room 128 Window						
Analyte	150 GLEN-0-1A 12/27/2006		150 GLEN-0-1B 12/28/2006		150 GLEN-0-1A 1/6/2007	
	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³	ppbv
Carbon tetrachloride	<1.3	<0.20	<1.3	<0.20	0.52 J S	0.083 J S
PCE	<1.4	<0.20	<1.4	<0.20	<1.4	<0.20
TCE	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

Outdoor Sample in Site		
Analyte	045160-Tufts-O-3A 10/2/06	
	ug/m ³	ppbV
PCE	<1.4	<0.20
TCE	<1.1	<0.20

Outdoor Sample in Site		
Analyte	045160-Tufts-O-4A 10/2/06	
	ug/m ³	ppbV
PCE	<1.4	<0.20
TCE	<1.1	<0.20

Outdoor Sample in Site		
Analyte	045160-Tufts-O-6A 10/2/06	
	ug/m ³	ppbV
PCE	<1.4	<0.20
TCE	<1.1	<0.20

Outdoor Sample in Site		
Analyte	045160-Tufts-O-6A 10/2/06	
	ug/m ³	ppbV
PCE	<1.4	<0.20
TCE	<1.1	<0.20

Phase II CSA and Phase III RAP
50 Tufts Street
Somerville, Massachusetts

UniFirst Corporation
Wilmington, Massachusetts



LABORATORY TESTING RESULTS-
OUTDOOR AIR SAMPLING

Project 04516-2 July 2008 Fig. 7-6

N:\04516\Drafting\045160-2\Phase II CSA Phase III RAP\045162-25

ATTACHMENT D

**JANUARY 26, 2009 COMMENT MEMO WRITTEN BY MS. ANNE MARIE C. DESMARAIS ON
BEHALF OF THE FRIENDS AND NEIGHBORS OF GLEN PARK**

To: Ileen S. Gladstone, PE, LSP, GEI
Irene Dale, MADEP

From: Anne Marie C. Desmarais, LSP, Environmental Insight

Re: 50 Tufts Street, Somerville, RTN 3-23246

Date: January 26, 2009

I have reviewed the IRA Status Report No. 6/RMR No. 9 and the Phase II Comprehensive Site Assessment, Method 3 Risk Characterization, and Phase III Remedial Action Plan with associated appendices for the 50 Tufts Street Site. I appreciate the opportunity to review these documents and provide preliminary comments prior to the Public Meeting. I will focus my comments on the Phase II CSA and the Risk Characterization, as well as on the Phase III RAP. I will provide formal comments on behalf of the Friends and Neighbors of Glen Park after the Public Meeting.

Overview:

The Phase II CSA, Risk Characterization, and Phase III RAP are consistent with the requirements of the Massachusetts Contingency Plan (MCP). I agree with the delineation of the Site based on the data developed by GEI and its subconsultants. I reviewed the DNAPL and Plume Stability reports provided by Dr. Kueper, and it is my opinion that the Site has been properly and adequately delineated, and that, although DNAPL is likely present at the Site, it is residual DNAPL in isolated pore spaces, and is not migrating. GEI relied on Dr. Kueper's assessments to support the conclusion that the plume is stable, and that the residual DNAPL is not acting as a continuing source of PCE, TCE, and/or TCA at the Site. The source has been adequately characterized, and is limited to soil and groundwater on the 50 Tufts Street Property, where it is being remediated using both SVE and SSDS. According to the IRA Status Report and the Phase II Report, 3,700 pounds, corresponding to approximately 450 gallons, of solvent have been recovered to date from the SVE system. Although the total amount of chlorinated solvent released at the 50 Tufts Street Property is unknown, this represents significant source reduction, and does not include mass reduction through the SSDS.

It is my opinion that GEI has provided sufficient and adequate documentation regarding the limits of the area that has been influenced by the release of solvents from 50 Tufts Street. This, in my opinion, is critical to the assessment. Because the plume is stable, and contaminants are no longer migrating, at least in the shallow and deep overburden aquifer, the conclusions in the Risk Characterization and the Phase III RAP can be considered valid for the entire Site area. GEI has demonstrated through multiple groundwater sampling rounds that the limits of contamination in the overburden aquifer have been stable over time.

It is possible that there is some migration of contaminants in the bedrock aquifer. The hydrogeologic investigations conducted by GEI demonstrate that there is a downward vertical gradient at the Site. GEI also reported that the shallow bedrock, which is a metamorphosed sedimentary rock, was weathered and highly fractured. GEI measured hydraulic conductivity in bedrock, and, although the values range over several orders of magnitude, the highest value measured was 2.2E-02 cm/sec, which is consistent with fractured rock. It is possible that chlorinated solvents, either in the dissolved phase or as DNAPL, could migrate in the fractured rock. However, because of the downward gradient and the sloping surface of the bedrock, it is not likely that any downgradient receptors would be affected by the release as the contaminants would not migrate from the bedrock aquifer to the overburden aquifer and, therefore, would not migrate into soil vapor.

I have reviewed the Risk Characterization, and agree with the method used to select and eliminate compounds from further consideration as COPCs. The methodology is appropriate and generally conservative. I have a few specific questions on the Risk Characterization, particularly regarding exposure parameter values.

I agree with the selection of the remedial action at this Site. Use of EPEMs, including SSDS and other site-specific methods, along with the SVE at the Property, is the most effective method of achieving No Significant Risk at the Site. It should be noted that this is a complex site, and that achieving background, which would mean removing all chlorinated solvents from soil and groundwater, is not feasible. The most effective way to remove and treat chlorinated DNAPL would be Dual Phase Extraction, but this would require disruption of the neighborhood with installation of multiple extraction points as well as construction of a treatment facility, and it would still be unlikely to achieve background. The selected remedy, particularly the use of EPEMs at residences, relies on reducing or eliminating exposure by changing a complete pathway into an incomplete pathway for migration of vapor into living spaces.

Using EPEMs, however, will require a commitment on the part of UniFirst and the owners of residences with remedies to ensure that the migration pathways remain incomplete. The following specific comments address my concerns.

Specific Comments:

1. The Phase III RAP notes that Activity and Use Limitations (AUL) "may" be necessary at buildings that have EPEMs to ensure that the systems remain in place and are operating properly. The Risk Characterization "presumes" that EPEMs are in place and are operating in residences and therefore does not include evaluation of an indoor air pathway in order to demonstrate No Significant Risk. The question of AULs for the Site has been discussed at Public Meetings. I have reviewed a copy of a draft AUL

agreement, and I understand that MADEP was also reviewing it. The validity of the results of the Risk Characterization depend on the proper function of EPEMs at all residences where there is evidence of a complete pathway, based on presence of VOCs in indoor air or of elevated VOCs in soil vapor under the slab. Without AULs or other methods to ensure that there are no complete pathways for vapor migration, the finding of No Significant Risk cannot be relied on for all receptors. Also, if a resident refuses an EPEM, and there is evidence of a complete pathway, the Risk Characterization will not be valid for that residence. These concerns should be addressed in both the Phase II CSA and the Risk Characterization.

2. The Risk Characterization also does not evaluate an indoor air pathway for future occupants in new residential or commercial at the Property because it “assumes” that any new construction will have a vapor barrier under the slab or will have other vapor mitigation measures incorporated into construction. The Phase II CSA also includes this “assumption” (page 83), and states that “a vapor barrier or other measure will be included as an integral part of the design and construction of any future building on the Property; therefore indoor air is not a complete exposure pathway for future residential or commercial receptors.” Without an AUL that requires vapor mitigation in new construction, there is no guarantee that this will be done. It will take several decades or longer before groundwater concentrations are reduced to levels that will not present an indoor air threat, and institutional memory is not sufficient to ensure that proper controls are implemented in future construction. This caveat should be extended to the other portions of the Site, where it is also possible that existing structures could be razed to make room for new residential construction. The example of the Capuano Center, where several homes were taken by eminent domain to allow for construction of the school, is evidence that new construction is possible even in established neighborhoods. One possibility is working with the City of Somerville to create a special district where all new construction or additions to existing buildings with new foundations would require vapor barriers.
3. CSA, page 45. Indoor air sampling at the Property does not include a “true” winter sample, where conditions would be optimized for indoor air migration (rising water table, deepest frost, minimal air exchange, and operation of the heating system). Most of the samples were collected in the summer, when lower values would be expected. What steps were taken to ensure that the samples were a reasonable estimate of seasonal worst-case air quality?
4. CSA, page 51. Indoor air samples were collected from 46 residences between April 8, 2007 and May 9, 2008. How many samples were

collected during the summer, and what steps were taken to ensure that these samples represented worst case?

5. CSA, page 56. Was an evaluation of the effect of local meteorological conditions done with respect to the outdoor air samples? The worst case for outdoor air quality would be in the winter, early in the morning on a day with little or no wind. As more EPEMs, particularly SSDS systems, are installed, there will be more sources of VOCs in the neighborhood. Under most meteorological conditions, there will be dispersion of VOCs, but winter inversions could trap VOCs near the ground. Future outdoor air sampling should be planned to coincide with worst-case conditions.
6. CSA, page 56. In Section 7.10.2, first sentence, the proper Figure is 7-6.
7. Risk Characterization, page 6. The RC notes that indoor air samples collected at the Capuano School after installation of the SSDS have "indicated no detectable concentrations of COPCs." However, the CSA notes that low levels of PCE were detected in Rooms 138 and 146 in July 2007. This was attributed to a migration pathway between the foundation wall and the slab. The pathway was identified and sealed. The concentrations were very low, on the order of $1 \mu\text{g}/\text{m}^3$, but did indicate that pathways may be identified in the future.
8. Risk Characterization, page 27. The left side of the second equation should read ADE and not ADD.
9. Risk Characterization, general. The Risk Characterization should specifically address gardeners at the Capuano Center as part of the qualitative discussion and note that exposures and risks for gardeners will be less than those of residents, so there is no need to conduct a quantitative assessment. The Risk Characterization does discuss gardens, but should include this in the qualitative assessment because this a concern of many residents, particularly because many people who have garden plots do not live within the boundaries of the Site.
10. Risk Characterization, Table RC-6, page 4. There is a single asterisk in the title, after "Streets", but there is no notation for a single asterisk in the notes.
11. Risk Characterization, Table RC-7. I have questions about several of the parameter values used.
12. The RC uses body surface area values for females for children, adults, commercial workers, and for construction and utility workers. A more conservative estimate would be to use the average for males and females for residents and commercial workers, and the values for males for

construction and utility workers. Males have larger body surface areas, and most construction and utility workers are male. Because the surface area value is in the numerator, a larger value is conservative, although it would be offset by a larger value for body weight in the denominator. What was the rationale for using females for construction and utility worker receptors?

The RC uses 16 years for the exposure period for adult residents. This is an established neighborhood, and 16 years may be too short to represent a reasonable worst case. With the exposure period values used, the maximum exposure is from age 1 to age 30, which is not half a lifetime, and therefore it is possible that cancer risk is underestimated. Given the nature of the neighborhood, a longer exposure period is likely for many residents.

The RC includes exposure to airborne particulates over for 150 days/year over 7 years for children, and over 16 years for adult residents. This may overestimate risk via this pathway. Contaminated particulates are generated when the soil is disturbed, and therefore during construction. The table shows a 182-day construction period. Because this pathway is a minor contributor to risk, however, changing the exposure period would have no effect on the calculated risks.

The RC uses 150 days/year (5 days/week for 30 weeks) for exposure to VOCs in outdoor air. This exposure frequency is appropriate for soil contact because outdoor activities in the winter do not involve contact with soil. However, VOCs are present in outdoor air in the winter. Residents can be expected to go outside year round, and therefore exposure to outdoor air could occur for 350 days/year. However, it is unlikely that residents are exposed to outdoor air for 8 hours/day. Table RC-7 uses 8 hours/day for outdoor air exposure and 24 hours/day for indoor air exposure for the same receptors. The values should be modified so that each receptor is exposed for 24 hours/day. For example, for a young child, 22 hours/day indoors and 2 hours/day outdoors. The same "outdoor" time should be used for exposure to particulates.

It is not clear from Table RC-7 if the indoor and outdoor air exposures for commercial and industrial workers are mutually exclusive. An "outdoor" worker, such as someone who works on a loading dock, would be exposed to outdoor air for 8 hours/day, but an indoor worker, such as an office worker, would be exposed to indoor air for 8 hours/day, and possibly to outdoor air for 1 hour/day. An auto body worker would likely be exposed to indoor air for 4 hours/day and outdoor air for 4 hours/day. The same worker cannot be exposed to both simultaneously.

For the student at the Capuano School, the RC uses a two-year exposure period. Is it possible for a child to be at the School for more than two years? For example, a child may repeat kindergarten. Also, Table RC-7 shows a non-cancer soil outdoor air, and indoor air averaging time of 2,555 days for the student. This value should be 730 days (365×2). It does appear that the correct value was used in the calculations. The table shows the young child exposed to indoor air at the Capuano School for 24 hours/day. The table uses 8 hours/day for exposure to outdoor air. The maximum time a child would be at the school would be from approximately 7:30 am to 5:30 pm if he/she participated in the after-school program, for a total of 10 hours. A portion of the day, possibly 2-3 hours, would be spent outside, and the rest of the time would be spent inside.

Table RC-7 notes that the landscaper's respiratory rate indicates "light exertion", but the value used is for heavy exertion.

13. Risk Characterization, Table RC-10. Carcinogenic Risk is not calculated correctly. Using one significant figure, the Cumulative Risk without Indoor Air should be $2.E-06$. When added to the indoor air risk, the total, using one significant figure, is $1.E-05$.

A general comment – if carcinogenic risks were calculated using two significant figures, some risks would slightly exceed $1.0E-05$. For example, the carcinogenic risks tabulated on Table RC-31 are greater than $1.0E-05$ if indoor air risks are used. However, as noted in my comment 11, the calculations appear to expose a worker to indoor air and outdoor air simultaneously. The calculations and exposure parameters should be reviewed to ensure that each worker is exposed for a total of 8 hours/day to either indoor or outdoor air.

14. The Risk Characterization should address exposures and risks to a teacher at the Capuano School. Teachers could potentially work at the school long-term, and a 27-year exposure period, identical to that used for commercial workers, can be used.
15. The Risk Characterization should address the likelihood that someone both lives and works in the Site area, and that a child who lives in the Site area goes to the Capuano School.

I look forward to the Public Meeting in the near future. I will be happy to discuss any of these comments with you. Thank you again for the opportunity to provide comments before the meeting.

**Response to Notice of Audit Findings
and Notice of Noncompliance**

50 Tufts Street, Somerville, MA
GEI Project No. 04516-3

Prepared by:



For: UniFirst Corporation
68 Jonspin Road
Wilmington, MA 01887

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www.geiconsultants

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